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BULLETIN OF THE TORREY BOTANICAL CLUB
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SOME CUTINIZED SEED MEMBRANES FROM THE COAL-BEARING ROCKS OF MICHIGAN

CHESTER A. ARNOLD

Because of the resistance of cutin to decay, plant tissues protected by this substance are often preserved even though all others have completely disappeared. Spore exines and fragments of leaf epidermis are the cutinized parts most commonly found in coal and plantbearing shales, but occasionally seed cuticles of the type described in this paper are found. In many ancient and a few modern seeds cuticles are present on some of the tissues of the interior. In one seed group, the Trigonocarpales, a cuticle covers the inner surface of the integument and the outer surface of the nucellus, and in other seeds there are cutinized or suberized tissues around the embryo sac. Frequently the cutinized spore coat immediately enclosing the embryo sac is visible in fossil seeds. In the seeds described in this paper almost all of the tissues have disappeared except the highly resistant cutinized internal cell layers, and the cuticles were pressed together as membranaceous films between the rock layers. These cuticles were freed by dissolving the rock, and many were removed intact. When first isolated they appeared as dark brown or black objects, but treatment with appropriate chemicals rendered them sufficiently transparent for microscopic examination. The original size of these seeds can be only estimated because in most of them all of the integument except the inner epidermis had decayed. Regardless, however, of the paucity of tissue preservation, some of these fossils show characters by means of which they can be classified.

Localities. The material described in this paper came from three coal mines in southern Michigan. Two of them are in Saginaw County near St. Charles. One of these, the Big Chief No. 8 mine, is within one-half mile of the northern limits of the town, and the other, the St. Charles-Garfield mine, is at Eastwood, three miles north of St. Charles. Both of these mines have been abandoned although they were in operation between 1929 and 1940 when the material was collected.

The third locality is the Woodville mine near the northeastern corner of the present city limits of Jackson. Its exact location is unknown because it was abandoned many years ago, and since then the shaft has been filled and the dump leveled. The fossiliferous rock from this mine is a piece of dark carbonaceous shale collected and labeled by Alexander Winchell, and placed in the museum of the University of Michigan many years ago. The date of collection is not on record but it may have been previous to 1860. The label

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bears Winchell's collection number 6526, and gives the depth as 97½ feet below the surface. On the label is the notation: "Vegetable tissue having minute cellular structure resembling modern Jungermanniales." It was this notation that prompted examination of the specimen. The vegetable tissue that Winchell noted, however, is the fragments of a small form of *Sphenopteris* (fig. 17) related to *S. obtusiloba*.

Age of the Material. All the coalbearing rocks in Michigan belong to the Saginaw group which is believed to be equivalent to the late Pottsville of the lower Pennsylvanian. At St. Charles the coals are at, or approximately at, the Saginaw coal horizon which is the oldest of the commercially valuable coals of the state. The position of the coal in the Woodville mine is uncertain, but the coals formerly mined in the vicinity of Jackson were generally assigned to the Verne horizon, which is higher than the Saginaw coal. However, practically no diagnostic fossils, either plant or animal, have been identified from any of the now abandoned mines at Jackson, and the position of the coal in the Woodville mine is entirely a matter of inference based upon evidence that is not conclusive. The numerous *Stigmariae* and stem casts formerly collected there in large quantities are all long-ranging forms that occur in abundance throughout the entire sequence of the Pennsylvanian system. However, the fact should not be overlooked that the seed cuticles from the two localities in Saginaw County, and presumably from the Saginaw coal horizon, are similar both in form and in manner of preservation to those from the Woodville mine, a similarity which indicates like environments of deposition if not contemporaneity. Also, the fact should be mentioned that the small *Sphenopteris* from the Woodville mine is of a type not yet found in Michigan as high as the Verne, although it is often abundant in the shales immediately above the Saginaw coal.

Technique. The plant cuticles were separated from the shale fragments by soaking them in dilute nitric acid for several days, followed by similar treatment in dilute caustic soda solution. The acid treatment is not essential because the shales disintegrate in pure water, but the process goes on faster and more thoroughly in acid and alkali. After the shale had broken down, the plant fragments were separated from the sludge with a fine sieve. They were then handled individually and macerated in Schulze's reagent. This was followed by treatment with dilute (about 1%) ammonium hydroxide. When more highly concentrated ammonium hydroxide was used, the cuticles tended to dissolve, especially after the Schulze's reagent had been allowed to act long enough to render the cuticles sufficiently transparent for microscopic examination. Prolonged soaking in Schulze's reagent always resulted in complete disintegration of the cuticles regardless of the subsequent treatment. The fragments were mounted in Diaphane directly from 95% alcohol.

Nomenclature of Fossil Seeds. Because of the detached condition of fossil seeds, it is often necessary to classify them separately from other plant parts. Seeds belonging to the same species may appear quite different if preserved in different ways. They are often preserved only as flattened compressions showing surface features but no internal structure. The symmetry is also distorted by the flattening. Many ancient seeds were provided with soft fleshy external coats which commonly decayed, leaving exposed on the surface of the fossil the more or less ribbed or lined stony subsurface layer. Thus the partially preserved seed may present an appearance quite different from the original. It is usually necessary to apply separate generic names to seeds preserved in different ways even at the risk of having more than one name for the same kind of seed. Although awkward in some respects, multiplicity of names helps to avoid much of the confusion that would otherwise ensue.

The system of seed nomenclature in most general use for Paleozoic seeds was proposed by Seward (5) who designated three groups, the Lagenostomales, the Trigonocarpales, and the Cardiocarpales. These categories for the most part embrace seeds belonging to the Lyginopteridaceae, the Medullosaceae, and the Cordaitae respectively. These "seed orders" accommodate the majority of seeds preserved as petrifactions or three-dimensional casts, but they are not always appropriate for compressions in which the natural symmetry has become altered. Also, some seeds with tissues preserved do not fit into any of these groups.

None of the seeds described in this paper can be identified with species already known, but one of them, because of the shape of the embryo sac and pollen chamber, can be referred to the genus *Physostoma* of the Lagenostomales. Another seed shows characteristics of the Trigonocarpales, but it cannot in the absence of certain essential features be assigned to any previously described genus. The author has placed it in a new genus, *Trigonocarpolithus*. Other seeds of more uncertain position are placed in the form-genus *Spermatites*. As stated, all these seeds are believed to belong to pteridosperms.

Rather little work has been done on seed cuticles, although spores associated with them have received the attention of a number of specialists. Among the few contributions on the subject of seed cuticles is one by Miner (3), who described several forms from the late Cretaceous of Western Greenland, and another by Harris (1), who named four genera from the Rhaetic of East Greenland. The seeds described by Harris, which are unattached and of questionable affinities, are believed to belong for the most part to cycadophytes and other gymnosperms. The distinguishing characters used by Harris are the thickness of the cutinized integument and nucellus, the extent of cutinization of the nucellus, the length of the micropylar canal, and

the presence or absence of a megaspore membrane. Since the Michigan seeds are not closely related to the Greenland forms, these characters are not applicable to them, although the type of preservation and the problems of interpretation are similar for both.

One of the significant features of the present study is the revelation of results that can be obained by use of maceration techniques in the study of

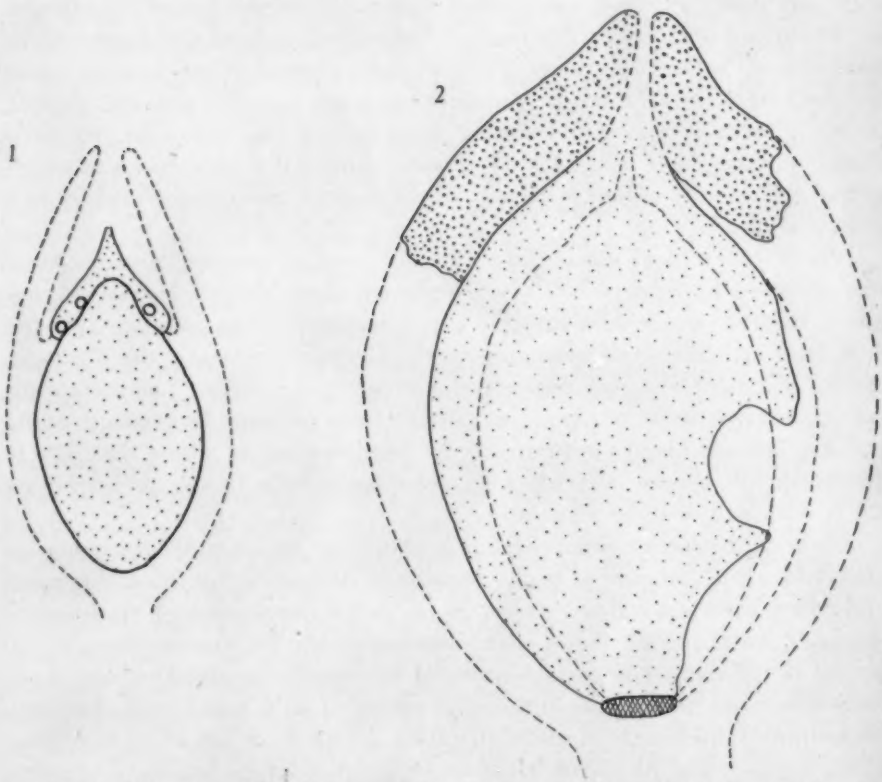


FIG. 1. *Physostoma Winchellii* sp. nov. Restoration of seed. The embryo sac and pollen chamber are outlined in solid lines and stippled. The assumed extent of the integument is shown by dashed lines. × 17. FIG. 2. *Trigonocarpolithus typicus* gen. et sp. nov. Restoration of seed. Restored portions are shown by dashed lines, and the preserved parts are bounded by solid lines and stippled. In the specimen from which this sketch was made, the nucellus is not visible, but its approximate position is indicated. × 17.

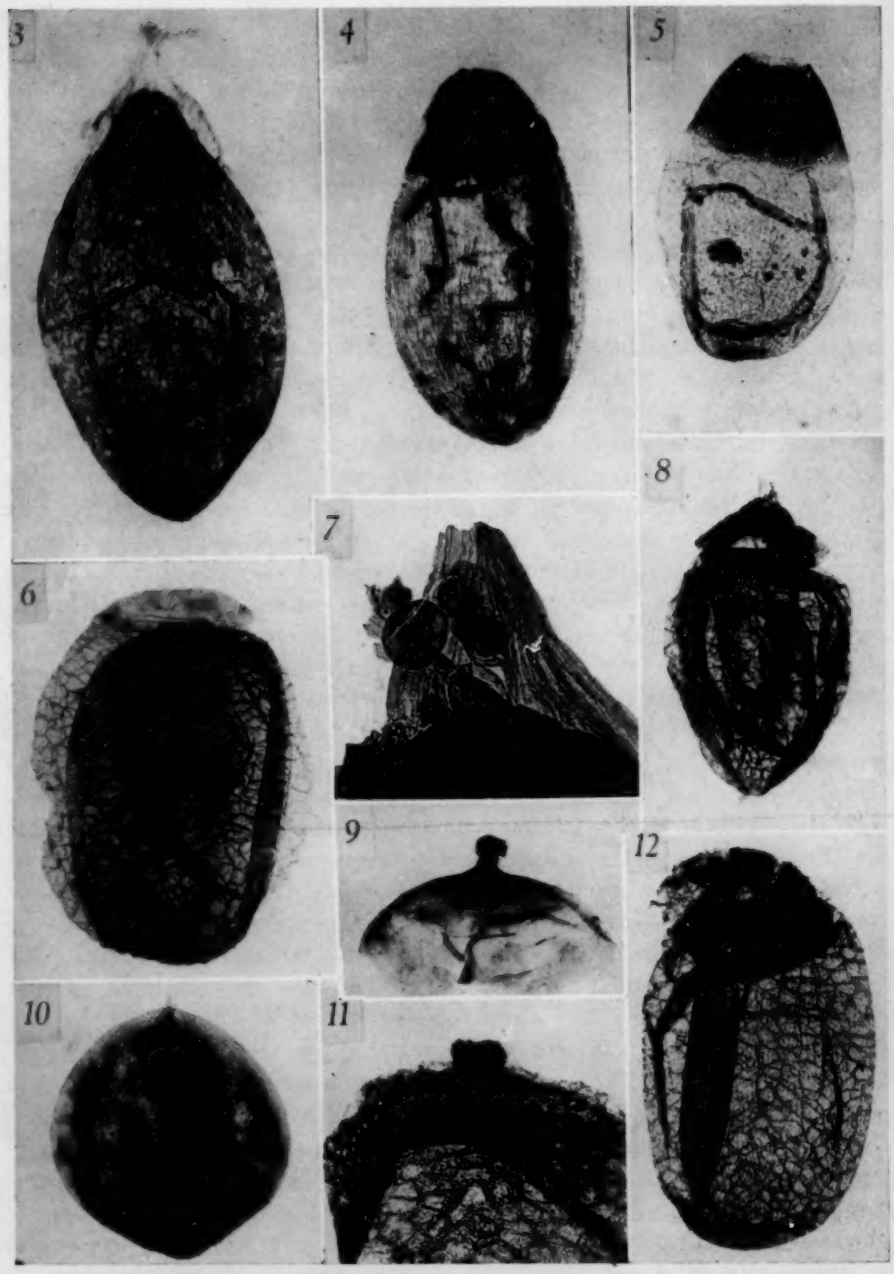
ancient vegetation. Not only are the techniques simple in themselves, but they are applicable to material that is available in large quantities, and more extended use of them would produce unexpected results.

LAGENOSTOMALES. In this group of Paleozoic seeds the integument is fused with the nucellus except in the region of the pollen chamber (as in modern cycads), and the vascular supply is restricted to the integument.

Members of the group are typically small, only a few millimeters in length, and in all known instances were borne in cupules. The group is typified by *Lagenostoma Lomaxi*, the seed of *Lyginopteris oldhamia*, but it also contains *Physostoma*, a seed first described by Williamson from the British Coal Measures, and elaborated upon by Oliver (4).

Physostoma Winchellii Arnold, sp. nov. (figs. 1, 3–5, 7). This name is proposed for a small seed found in considerable numbers at the Woodville and Big Chief No. 8 mines. The cutinized parts are small oval bodies ranging from 950 to 1450 microns in width, and 1600 to 2650 microns in length. Some, possibly immature ones, are smaller, and occasional ones are slightly larger, but the majority fall within the limits of these measurements. The bodies are broadest at the middle and rounded at both ends, but the apical end is slightly narrowed where a conical cap fits over it, formed from epidermis of the tissue enclosing the pollen chamber. This cap is about 1 mm. broad at the base in an average specimen, and a little more than 1 mm. high (fig. 3). In most specimens the tip of the cap is broken off (figs. 4, 5). The cap is made of slender, thick-walled cells that extend lengthwise and converge toward the ostiole. Although the dimensions vary considerably, these cells are roughly 20 μ broad with wall layers about 8 μ thick separating adjacent cell cavities. The length of these cells is difficult to determine because of the slightly tortuous course they follow. At the base of the cap is a border about 3 cells wide, in which the cells are shorter than the others.

The egg-shaped cuticular bodies described in the preceding paragraph represent the inner layer of tissue immediately surrounding the large internal object which Oliver (4), in his description of *Physostoma elegans*, calls the "embryo sac." Although no embryo has been found within this sac, the term nevertheless is appropriate because it is here that the embryo would have formed whenever that stage in ovule development would have been reached. The sac is really a female gametophyte enclosed by the stretched and distended wall of the spore from which it originated. This spore is commonly called a "megaspore," but this apparently is not the proper designation for it in view of the observations of Thomson (6) on the relative sizes in seed plants of the spores that give rise to the pollen and female gametophytes. Thomson has found that in seed plants, the spore that is commonly called the megaspore is not consistently larger than the so-called microspore, and in many plants is actually the smaller of the two. Furthermore, he found that the application of the names "microspore" and "megaspore" to seed plants is based upon a misinterpretation of Hofmeister's work in which the cell from which the embryo sac develops is simply referred to as a "spore." In *P. elegans* the "embryo sac" with its enclosing cutinized membrane is surrounded by a tapetum which shows in thin sections of petrifactions as a black, more or less structureless layer about 100 microns thick.



FIGS. 3–5. *Physostoma Winchellii* sp. nov. × 22. FIG. 6. *Spermatites reticulatus* sp. nov. Specimen containing a large thin-walled spore. × 30. FIG. 7. *Physostoma Winchellii* sp. nov. Portion of apex of embryo sac showing pollen grains in the pollen chamber. × 100. FIG. 8. *Spermatites reticulatus* sp. nov. Specimen with conical cap in place. × 26. FIG. 9. *Spermatites cylix* sp. nov. × 6.5. FIG. 10. *Spermatites globosus* sp. nov. × 9.5. FIG. 11. *Spermatites reticulatus* sp. nov. Apical portion with conical cap removed showing the short papilla. × 38. FIG. 12. *Spermatites reticulatus* sp. nov. × 30.

The tapetum in turn is surrounded by a layer of delicate secretory cells. The outer part of the nucellus is joined to the inner surface of the integument except for the free portion at the apex which is crowned by the pollen chamber. The pollen chamber in *Physostoma* is distinctive in that the upwardly arched apical part of the "embryo sac" indents the bottom of the pollen chamber like the incurved bottom of a wine bottle. Although in our material nothing is preserved except the tapetal layer surrounding the "embryo sac" cavity, and the apical cap which encloses the pollen chamber, the whole structure is sufficiently like that part of *Physostoma elegans* to render identity with that genus a matter of practical certainty. The other characteristic of *Physostoma,* the splitting of the integument into free tentacles where it overarches the pollen chamber, is not visible in our specimens.

The tapetum surrounding the "embryo sac" and the tissue enclosing the pollen chamber are the most decay-resistant structures in *Physostoma,* and as a result are preserved after other parts of the seed have disappeared. No traces of the original spore membrane can be detected. Oliver states that the spore in *P. elegans* has a very thin membrane which is difficult to detect. The tapetum in the ovule in seed plants in general is believed to be derived from sporogenous tissue, which could be the explanation of its cutinized or suberized condition.

In the material under consideration, the tapetum surrounding the central cavity is evidently cellular. Originally the cells were dark, but under the influence of Schulze's reagent they bleach to a reddish brown. Oliver describes the tapetum as a black structureless layer which has been compressed by the growing gametophyte and infiltrated with dark substances secreted by the adjacent external layers. In a few specimens something can be ascertained concerning its cellular composition, but nowhere is the structure well preserved. In specimens of *Physostoma Winchellii* that have been subjected to rather prolonged treatment with Schulze's reagent, the cell outlines are dimly revealed. They appear to be thin-walled, four- to seven-sided, and mostly longer than broad. It is difficult to measure these cells accurately, but they average about 45 μ in breadth.

In some of the specimens the tapetal jacket is surrounded by a thin layer of long, slender, lengthwise-extending cells very similar in shape to those composing the jacket of the pollen chamber. This tissue appears to be two or more cells deep, and the cell walls are thin and light brown. This apparently is part of the nucellus although its exact identity is uncertain. It seems to lie adjacent to the tapetal layer but is not firmly attached to it. It is possible that originally there was an intervening secretory layer which has disappeared, leaving the two layers in contact but not organically connected.

Oliver comments upon the abundance of pollen grains in the pollen chamber of *Physostoma elegans*. In one section 30 grains were counted, and 17 in another. Broadly oval pollen grains are fairly abundant in some of our specimens but the most to be found anywhere is thirteen. These grains measure 81 by 94 μ (fig. 7). Their structure is not clearly discernible because they can be seen only through the layer of cutin that surrounds the pollen chamber, but each one appears to contain a central cell enclosed by a jacket of nearly transparent cells. Their dimensions are nearly twice those of the pollen grains attributed to the British species.

The foregoing description is based upon more than a dozen specimens, some of which reveal the structure better than others. Their generic identity with *Physostoma* is obvious even though the genus was originally based upon material preserved in coal balls and in which all the tissues were more or less intact. In our specimens the peculiar integument has completely disappeared, and the only remaining parts are the tissues enclosing the "embryo sac" cavity and the pollen chamber. The distinguishing features are the shape of the embryo sac and the pollen chamber, and the fact that similar pollen grains are present in considerable numbers.

Although these seed cuticles show obvious relationships with *Physostoma elegans*, they display sufficient differences to require a separate specific name. The original complete seed was certainly smaller than *P. elegans* in which the "embryo sac" is nearly 5 mm. long. In our seed this body is only about one half as long but in proportion is slightly broader. Judging from the size of the preserved part, *P. Winchellii* was probably about 4 mm. long and from 2 to 2.5 or possibly 3 mm. in width. In addition to an apparent difference in size and shape, the pollen chamber in our species is a trifle more massive and more acutely conical. A pronounced difference in the size of the pollen has already been mentioned.

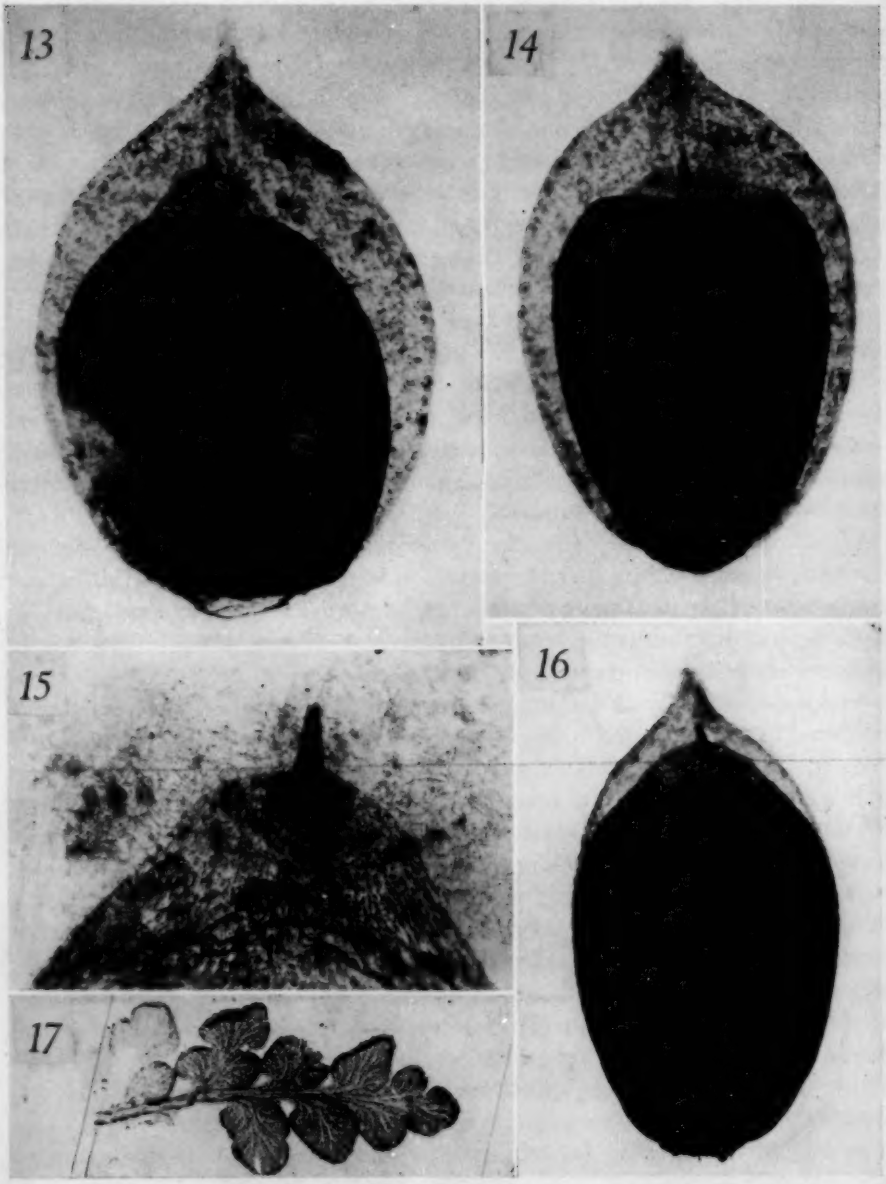
TRIGONOCARPALES. This group of Paleozoic seeds, believed to belong for the most part to the Medullosaceae, possesses several distinctive features which enable its members to be recognized even when very imperfectly preserved. The main body of the seed possesses radial symmetry. Except for its basal attachment, the nucellus is free from the integument, and the apex of the nucellus contains the pollen chamber which is surmounted by a hollow slender beak through which the pollen passes on its way to the pollen chamber. This beak, at pollination time, fitted more or less directly into the micropyle. The inner surface of the integument is covered with a fairly thick cuticle, and the epidermis of the adjacent nucellus is similarly reinformed. There thus exist in these seeds two protective layers which under proper conditions of preservation retain the outlines of the integument cavity and the form of the nucellus.

Trigonocarpolithus Arnold, gen. nov. This generic name is proposed for seed cuticles which, because of the presence of separate layers representing the lining of the integumentary cavity and the covering of the nucellus, show evidence of affinity with the Trigonocarpales, but which owing to the disappearance of essential diagnostic features in the integument, cannot be assigned to any previously described genus. Fully aware of the multiplicity of names already in existence for fossil seeds, and cognizant of the fact that many of these names exist only because of the different ways seeds are preserved, the author proposes another one only after considerable deliberation and with the full conviction that it is necessary. Regardless of the superabundance of generic names for fossil seeds, occasions still arise when more are needed, and in this particular instance the only other possible course would be to resort to the designation *"Carpolithus"* which simply means a fossil seed. This name should not be used where affinities are as much in evidence as they are here. Of course, fossil plants can always be left unnamed, but they then have no taxonomic status or convenient means of reference.

The reason these seeds cannot be assigned to any previously defined genus is because of the poor preservation of the integument within which tissue most of the generic characters of this "order" are expressed.

Trigonocarpolithus typicus Arnold, sp. nov. (figs. 2, 13–16). This species is based upon 10 specimens from the Big Chief No. 8 mine at St. Charles, in shale collected by the author about 1930. All the specimens are fairly uniform in size, and range from 3 to 4.5 mm. in diameter and from 6 to 7 mm. in length. They are oval or slightly ovate in shape, usually broadest above the middle, and have a rounded base and an obtuse, cuspidate apex. The small apical tip represents the lining of the lower part of the micropyle. The outermost cuticular layer, which represents the lining of the integumentary cavity, is light yellow in color, and shows the pattern of a layer of slender, vertically elongated cells having small cross diameters. The cell outlines are not very distinct, and fragments of the tissue originally adjoining them on the outside are frequently present but not well preserved. In fact, the entire outer surface is somewhat rough owing to former cell attachments. At the very base of the body is an opening slightly less than 1 mm. in diameter, which is sometimes filled with black material, and through which the tissue of the nucellus was attached to the integument (fig. 13). The edge of this opening is ornamented with a fringe of hair-like cuticular projections.

Enclosed by the integumentary cuticle is the cuticular membrane which surrounded the nucellus. This is similar in shape to the cavity within which it is contained but in most instances has shrunk somewhat and is smaller (figs. 13–16). It is attached at the base and terminates in the upper part of



FIGS. 13, 14. *Trigonocarpolithus typicus* gen. et sp. nov. × 10. FIG. 15. *T. typicus* gen. et sp. nov. Apex of nucellar cuticle showing the dome-shaped pollen chamber and the apical beak. × 35. FIG. 16. *T. typicus* gen. et sp. nov. × 10. FIG. 17. *Sphenopteris sp.* (cf. *S. obtusiloba*). × 2.

the enclosure directly beneath the micropylar opening. In some specimens where the shrinkage has been relatively slight the nucellus fills the cavity except in the upper part (fig. 16).

The nucellar cuticle is reddish brown and darker than the enclosing membrane, and stands out conspicuously from it. The apical part is prolonged slightly upward around the pollen chamber (fig. 15), which has the shape of a low, broad bell or an inverted champagne glass. At the apex is a prominent beak which, before shrinkage had altered its position, projected into the base of the micropylar tube. This beak is 225–275 μ long and tapers from a diameter of about 110 μ at the base to 75 μ at the tip. In some specimens where the upper part of the nucellus has collapsed, the beak has fallen away from its original position (fig. 14). Even when displaced, it can usually be located by its shape and dark color among the disorganized contents of the integumentary cavity.

No pollen grains have been seen inside any of the specimens although the space occupied by the pollen chamber is distinct from the other part of the nucellus and stands out from it as a lighter colored area (figs. 13, 16). The upper margin of the female gametophyte cavity can be recognized as the slightly upwardly bulged floor of the pollen chamber. No gametophytic tissue can be recognized although some of the more darkly colored substances within the nucellar sac may be fragments of the thin enclosing spore exine.

The cuticular bodies described here are strikingly similar in form to the inner lining of the integument and the orthotropous nucellus of the seed often figured as *Trigonocarpus Parkinsoni*. It differs from this seed in being smaller and more broadly oval.

One of the specimens from St. Charles shows a small portion of the integument still attached to the micropylar end, and from this it is possible to form some idea of the probable shape of the original seed as it would have appeared in longitudinal section (fig. 2). The long micropyle of the type usually shown in *Trigonocarpus* is apparently lacking, and the integument appears to have been of fairly uniform thickness. In the part preserved, the integument is about 0.75 mm. thick. No cell structure is revealed. The micropyle is full of opaque material and a small portion is broken away from the extreme apex.

If that part of the integument preserved in this specimen is representative of the tissue in a complete seed, the seed was an oval body about 5 mm. in diameter and 7 or 9 mm. long. Although obviously a member of the Trigonocarpales, it is smaller than the typical members. Nothing is known of the shape of the seed as it would have appeared in cross section.

Semina Incertae Sedis. Under the heading of "Semina Incertae Sedis" three fossils are described which are evidently seed remains but

which cannot be assigned to any particular group. In order that they may have taxonomic status they are referred to the form-genus *Spermatites* which was proposed by Miner (3) for similarly preserved objects believed to be seeds from the Upper Cretaceous of Greenland. No relationship, however, with the Greenland fossils is implied. The name is chosen in preference to *Carpolithus* which has been widely used for any kind of seed or seedlike object preserved in any form. Although our seeds do not conform to *Spermatites* exactly as Miner defined it, the name is entirely appropriate as it was intended to provide a convenient designation for any unassigned seeds or ovules for which no suitable name exists.

Spermatites reticulatus Arnold, sp. nov. (figs. 6, 8, 11, 12). This very distinctive seed cuticle is abundant at all three localities. The saclike body is an oval object ranging from 1568 to 2274 μ in diameter and from 2274 to 3058 μ in length. It is broadest at the middle, with an evenly rounded base and a somewhat flattened apex which is terminated by a short blunt papilla about 182 μ broad and 90 μ high (fig. 11). In complete specimens the apex is covered by a low conical cap with a terminal ostiole (figs. 6, 8, 12) which hides the papilla.

The cutinized membrane constituting the body is thin and of light amber color. The cellular pattern is peculiar. The cell outlines are irregularly angular, measuring as much as 154 by 318 μ, and usually with the longer dimension transverse to the long axis (figs. 6, 12). The pattern consists of a system of surface reticulations which, as one may see by examining the edge, are slightly raised. These reticulations are about 15 μ thick. Being low surface ridges, one might conclude that they represent the material filling the crevices between the original cells and that the whole sac is the inner lining of tissue enclosing a cavity similar to the integumentary cavity of *Trigonocarpolithus typicus*, previously described. This interpretation, however, is questioned because the clean outer surface of the sac and the complete absence of adhering tissue fragments would indicate that this surface represents the original outer one of the tissue of which it was a part. The reticulations may be the result of shrinkage of the thinner portions on the cell surfaces.

The membranaceous sacs are somewhat folded and crumpled from flattening, and most of them are empty (fig. 12). Within a few specimens an oval noncellular body is visible, slightly darker than the enclosing jacket, that resembles a large spore. In one specimen (fig. 6) the outer envelope showing the surface pattern measures 2274 by 2705 μ in breadth and length, and encloses a large spore that extends the full length of the internal cavity. Its width, however, is slightly less, only 1803 μ. This enclosed body is somewhat creased as a result of flattening, and originally it probably filled the space. At the apex of the sac is the short papilla, which has been pushed slightly downward.

The conical cap which crowns the apex is loosely attached (figs. 8, 12). In many specimens only fragments of it remain, and in some it has completely disappeared (fig. 11). The cap is circular at the base, and ranges from 1250 to 1750 μ in diameter, depending upon the size of the sac. The lateral margins slope upward forming an angle slightly greater than 90° to each other, and the tip is prolonged into a short tube which, though not found complete, is at least 180 μ high and 110 μ broad (fig. 8). In another specimen the tube is broken off leaving an apical pore 88 μ in diameter (fig. 12). The tube is lighter-colored and more delicately constructed than the part below it.

The cells of the cap below the apical tube are elongated lengthwise and converge toward the opening. These cells are quite irregular, but they average about 30 μ in width. Those nearest the apex of the cone are only slightly longer than broad. Lower down they become longer, some being as much as 250 μ long. At the basal margin there is a border of nearly isodiametric cells.

Situated as it is over the apex of the closed sac, the conical cap is evidently a structure designed for the reception of pollen. In one specimen a few probable pollen grains can be seen within, two of which measure 46 by 73 μ and 46 by 76 μ. They are broadly oval but nothing is visible within them. These bodies are never present in large numbers and whether they are the pollen of the same plant to which the seed belongs, or extraneous material, is unknown. However, they are all of nearly uniform size, and could readily have passed through the opening in the apical tube. If their presence is purely accidental, one would expect to find among them objects of smaller size.

These cutinized sacs are evidently portions of seeds. The probability that they are cryptogamic sporangia is militated against by their structure and by the absence of small spores inside the main cavity. What is apparently a single large spore occupying most of the space within is strongly suggestive of the seed spore of some primitive pteridosperm. The presence of the small apical papilla beneath the apical cap suggests nucellar tissue. Whether this papilla originally projected into the opening of the cap is unknown, but from its position and relation to the cap (which evidently enclosed a pollen chamber), it bears much resemblance to the "tent pole" of the *Ginkgo* ovule or to the upward prolongation of the nucellar tissue in *Physostoma* and other seeds of the Lagenostomales complex.

A puzzling feature shown by these sacs is the absence of any evidence of basal attachment. The membrane is complete over the rounded base. If these objects belong to the Trigonocarpales, as one might suspect from the apparently free nucellar surface, there should be an opening at the base where the nucellus was attached at the bottom of the integumentary cavity. Affinity with the Lagenostomales would be indicated if there were any tissue

fragments adhering to the outer surface, in which case the cuticle would be comparable to the inner layer surrounding the "embryo sac" described for *Physostoma Winchellii*. The situation exhibited here reminds one of Loubière's description of *Leptotesta*, the seed of *Pecopteris Pluckeneti* (2). In this seed the nucellus is described as being free at the base as well as along the sides, the only attachment being by means of a collar near the apex. Too little is known of *Leptotesta* or *Spermatites reticulatus* to warrant any assumption of identity, although the possibility should not be ignored that the kind of structure described for *Leptotesta* might, under certain conditions of preservation, produce the type of fossil described here.

Spermatites globosus Arnold, sp. nov. (fig. 10). This type, represented by only a few specimens, consists of a large, rather thick-walled spore invested by a delicate thin-walled cellular membrane. The spore, which measures 3.0 by 3.2 mm., is nearly round, although it is slightly prolonged at each end. The shape somewhat recalls that of a naval orange. The wall is about 12 μ thick, smooth, and light yellow in color.

On the best preserved specimen (fig. 10) the tissue investing the huge spore is very light colored and rather fragmentary. The cells of the tissue layer adjacent the spore are nearly rectangular, averaging about 36 by 40 μ, and have the longer dimension lengthwise. At the apex the investing tissue is prolonged into a narrow protrusion which cannot be accurately measured because it is incomplete. Whether it is tubular is not certain but the transparency of the cells suggests that it is. Neither pollen chamber nor pollen grains are visible.

This somewhat problematic structure is suggestive of a primitive ovule with a single large spore enclosed by a delicate nucellus. Primitiveness is indicated by the thick spore wall. It is likely that gametophytic tissue developed within while the spore was still within the sporangium, because the investing tissue renders rather improbable any assumption that the spore was ever free.

Spermatites globosus has been found only in the shales from the Big Chief No. 8 mine at St. Charles.

Spermatites cylix Arnold, sp. nov. (fig. 9). The interesting but puzzling specimen described under the above name appears to be the apical portion of a very large spore. The fragment is 5.5 mm. broad, and judging from the curvature of the margin, the complete body might have been 8.0 mm. in diameter. There is no basis for estimating its length. A peculiar feature is the short, columnar apical projection which is about 0.4 mm. broad and nearly 0.75 mm. high. This necklike column is filled with opaque material which has oozed out of the end in a mushroom-shaped mass. The neck appears originally to have fitted into a micropylar opening. The opaque contents obscure structural details so it is not impossible that the neck is separate

from the main part of the spore body, but there is no evidence of connection of two parts along the smooth margin.

The spore body consists of smooth, heavily cutinized exine without recognizable surface ornamentations. Although its thickness cannot be measured, the exine appears to be relatively thin. Fragments of delicate cellular tissue adhere to the exine in places. The cells are irregular in shape, but tend to be rectangular, and they vary from 20 to 55 μ in diameter by 50 to 100 μ in length. There is a definite inverse relation between breadth and length, the narrow cells being longer than the broader ones.

Although the morphology of the above described object is questionable, it appears to represent a fragment of a very large spore of some primitive pteridospermous seed. The black material bulging from the narrow neck reminds one of the gametophytic tissue that swells through the cracks of some lycopodiaceous spores. It is not likely, however, that this is a lycopod, but it may be a stage in seed development on a level with an advanced lycopod.

The only specimen so far found came from the Big Chief No. 8 mine at St. Charles.

SUMMARY

The foregoing account is concerned with compressed seeds preserved as thin cuticle layers that originally enclosed or lined tissues within seed, and large sporelike bodies believed to represent embryo sacs. They are preserved in carbonaceous shales from the Saginaw group of lower Pennsylvanian age, in southern Michigan. The material was prepared for study by softening the shale in dilute nitric acid, and then macerating the individual specimens in Schulze's reagent. Diaphane was the mounting medium.

Physostoma Winchellii sp. nov., a representative of the Lagenostomales, is a small oval body averaging about 1 by 2 mm. in breadth and length, and consists mainly of a layer believed to represent the tapetum of the "embryo sac." Its dome-shaped apex indents the bottom of the pollen chamber in which nearly spherical pollen grains are sometimes preserved. There is a general resemblance to *Physostoma elegans*, but the complete seed was smaller and slightly broader in proportion to its length.

Trigonocarpolithus typicus gen. & sp. nov. is a member of the Trigonocarpales, but lacks features essential for identification with any known genus. The outer covering represents the lining of the inner surface of the integument, and the enclosed nucellar cuticle, which is free from the integument except at the base, shows a well developed pollen chamber bearing an apical beak. The reconstructed seed is an oval body about 5 mm. in diameter and 7–9 mm. in length. Its structure was essentially like that of *Trigonocarpus* and *Pachytesta*.

Three other objects, believed to represent parts of seeds, are assigned to

the form-genus *Spermatites*. *Spermatites reticulatus* sp. nov. is a barrel-shaped body having a maximum length of about 3 mm. which shows a characteristic cellular pattern. The outer surface is believed to represent the nucellar surface but there is no evidence of lateral or basal attachment. A single large spore nearly fills the internal space. The cone-shaped pollen chamber contains a few pollen grains. *Spermatites globosus* sp. nov. is a large, thick-walled, nearly globular spore invested by a delicate cellular layer believed to be the nucellus. The spore is neary 3 mm. broad and of slightly greater length. *Spermatites cylix* sp. nov. is the fragment of a very large but apparently thin-walled spore with a short, stout apical neck through which the enclosed gametophyte possibly came in contact with the external environment. Its morphology, however, is questionable.

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GAMETOPHYTE DEVELOPMENT IN TAXUS CUSPIDATA

CLARENCE STERLING

The position of the Taxaceae in the Coniferales has long been contended. Particularly in *Taxus*, the simplicity of ovular organization as well as the uniqueness of construction of the microsporophylls are variously interpreted. These characteristics have been indicated as primitiveness on the one hand and as reduction on the other. Admittedly, embryology may not be decisive in determining phylogenetic relationships. Nevertheless, a consideration of the reproductive morphology in a member of this family cannot fail to be of value in elucidating its relative position. In view of the differences in embryological development which have been found among the various species of *Torreya* (Robertson 1904a, b; Coulter & Land 1905; Buchholz 1940; Tahara 1940) and among those of *Cephalotaxus* (Arnoldi 1900; Coker 1907; Lawson 1907), added interest attends the study of a hitherto unexplored species of *Taxus*.

Materials and Methods. Ovules of *Taxus cuspidata* Sieb. & Zucc. were collected from ornamental plantings on the campus of the University of Illinois in Urbana, Illinois. Collections were made at weekly intervals from April 7 to September 1 during 1946, and additional mature seeds were taken on September 29 and October 19 of the same year. The chronology of development was checked with further collections in 1947. Embryo sacs were dissected out and studied as whole mounts. In addition, many ovules were exposed on two sides and immersed in Carnoy's fluid. After this procedure, these ovules were cleared in chloroform and embedded in paraffin. Sections were cut at 10 μ and stained principally with tannic acid–iron chloride, acid fuchsin, and fast green.

Megasporogenesis. Pollination occurred about March 15–20 in 1946.[1] When the first collections were made a few weeks later, the pollen grains had germinated, and short tubes had penetrated the irregular apex of the nucellus. At this time, the ovules varied in their rate of development. In some, megaspores were already 4-nucleate; in others, meiosis had not yet occurred; but in all the micropyle was completely closed (fig. 17).

At the time of megasporocyte differentiation, the cell rows of the nucellus appear to have a coaxial[2] aspect (as noted by Strasburger 1879, 1904, and

[1] About a month later (April 10–15) in 1947. The chronology of development in 1947 was generally about a month later for all phases of reproductive activity.

[2] Recently, Foster (1943) has discussed the histogenesis of the coaxial type of structure in the shoot apex of *Microcycas*.

Jäger 1899), in which the cell lineages from above converge downward toward the center of the structure. In the upper half of the nucellus, the cells are isodiametric and have large vacuoles. They are larger and have thicker walls than the smaller, more densely-staining cells of the lower half. These latter are meristematic, dividing principally by transverse walls.

At the approximate juncture of these two zones is differentiated a small central area of about 20 cells, as seen in longisection (fig. 14). These cells are at the lower terminus of the coaxial rows mentioned above and are continuous with those rows, as described also by Dupler (1917, 1920). Possibly this area may be designated as sporogenous tissue. Its cells stain much more deeply than their neighbors; their cytoplasm is denser; and they have a higher nuclear : cytoplasmic ratio. They are further characterized by containing one or two large, very darkly-staining bodies in the cytoplasm, usually toward the end(s) of the cells (figs. 2, 4, 14). These bodies have also been noted by Coker (1904) and Strasburger (1904). Similar structures have been reported in the megaspore-mother cells of *Torreya* (Robertson 1904a), *Juniperus* (Norén 1907; Ottley 1909; Nichols 1910; Mathews 1939), *Widdringtonia* (Saxton 1910), *Fitzroya* (Doyle & Saxton 1933), *Taxosium* (Coker 1903), and *Larix* (Juel 1900). In the absence of cytological information concerning their function, the localization of these dense areas in the megasporocytes is of uncertain significance.

It is evident that the rows of sporogenous cells are related to the more lightly-staining files of vegetative cells in the upper half of the nucellus above, having arisen by successive transverse divisions in the cells of these files. However, since the sporogenous cells are set off from their sister vegetative cells only by virtue of their position, it appears quite likely that the influence of the whole organ is more decisive for the differentiation of these cells than a presumed origin from an archesporial cell or group of cells.

Differentiation of the sporogenous tissue is accompanied by divisions in the neighboring cells, parallel to the periphery of this tissue. In addition, some tangential divisions occur also in the more peripheral cells of the sporogenous group. The cells produced by these divisions do not enlarge, and consequently their origin is easily ascertained. Repeated parallel divisions give rise to rows of cells which appear to radiate from the central area, creating the configuration of a concentric grouping of surrounding cells (figs. 1–5). This configuration is most marked above the sporogenous area. It is independent of the original cell pattern, resembling fiber origin in the gourds of *Luffa* (Sinnott & Bloch 1943).

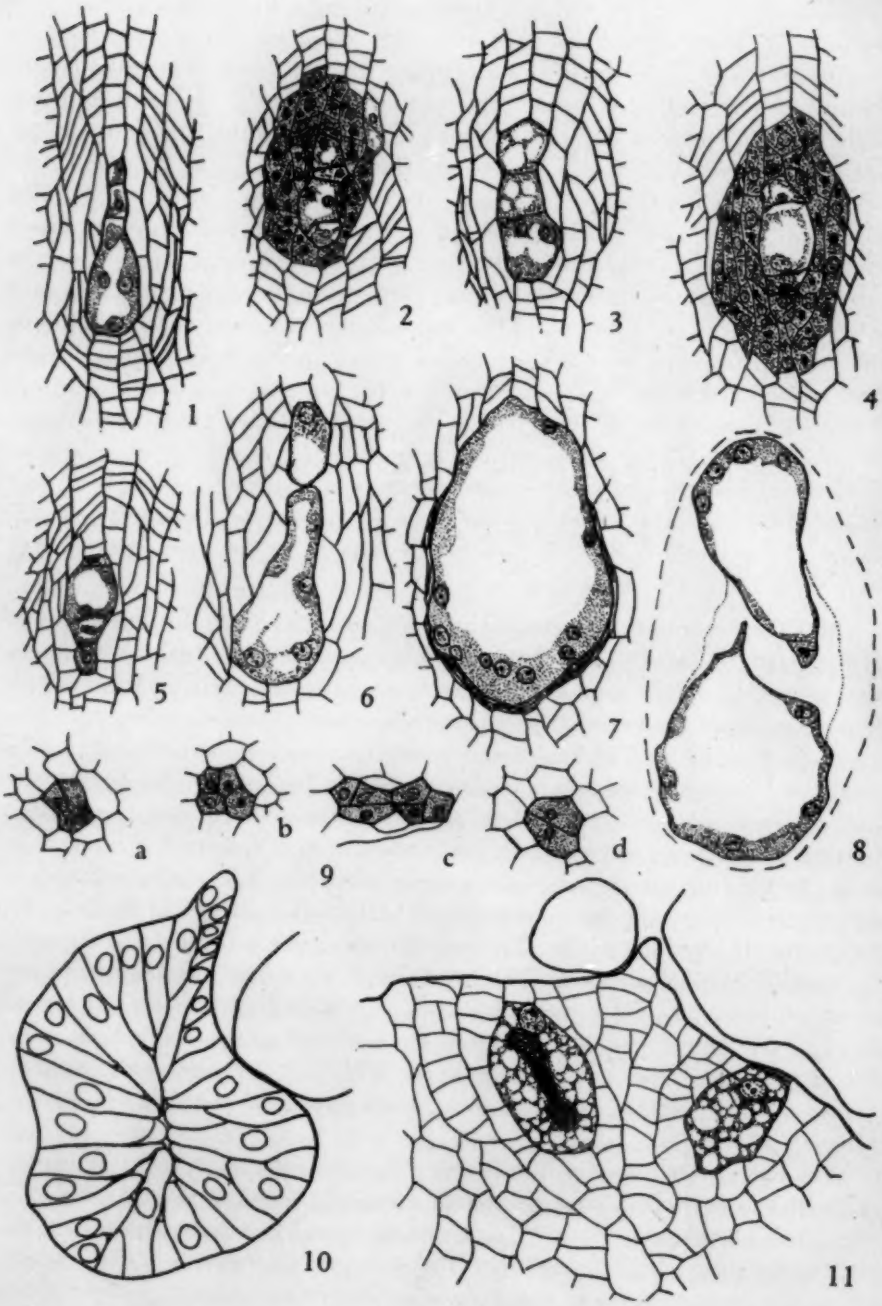
Although ovules were often seen in which two or even three sporogenous cells had enlarged and could possibly qualify as megaspore-mother cells, more than one linear row of megaspores was not found during the present investigation. The possibility of an occasional case of plurality of mother

cells cannot be ruled out, but it is obvious that such a condition is relatively uncommon. (Strasburger in 1879 and 1904 reported 3–5 mother cells in *Taxus*, and both Jäger in 1899 and Dupler in 1917 noted that occasionally two megaspore-mother cells undergo meiosis.) Generally one cell, approximately in the center of the sporogenous group, becomes the functional megasporocyte, as was also found by Coker (1904).

The meiotic divisions occur mainly from about the time of pollination to several weeks later. Some ovules appeared to be delayed in development, and both sporogenous tissue and linear tetrads of spores were found as late as May 12, almost two months after pollination. Because of the intensive study of Strasburger (1904) and the well documented observations of others, the meiotic divisions were not studied in detail. A metaphase figure of the first reducing division is shown in figure 12. The end result of meiosis in *Taxus* has been variously described as three (Hofmeister 1862; Strasburger 1879) and four (Coker 1904; Strasburger 1904; Dupler 1917) megaspores. Both conditions seem to occur commonly in *Taxus cuspidata* (figs. 1–5), and Jäger (1899) has also noted this variation in *T. baccata*. Depending on the shape of the mother cell, the form of the spores in the linear group may vary from tabular to elongated.

Megagametophyte Development. As a result of the investigations of Hofmeister (1862), Dupler (1917), and others, it is sufficiently well known that any or all of the megaspores may begin to "germinate" (figs. 1–6, 8). Most commonly, however, it is the larger, most chalazally situated spore which is functional. The functional spores may enlarge while still uninucleate and soon acquire a large central vacuole before the nucleus divides (fig. 4). In other cases, the nucleus may divide once or twice before the enlarging vacuoles of the megaspore coalesce to form the central vacuole (figs. 2, 3). As the functional spore enlarges, the non-functional ones disintegrate, and their contents appear to be resorbed. Although as many as three spores were seen to germinate (fig. 3), usually only one continues development beyond the uninucleate stage. The presence of two active megagametophytes in an ovule is sufficiently uncommon to be remarked (figs. 6, 8). In a sampling of 250 ovules, only 14 possessed two developing prothalli. None were found with more than two gametophytes. This is to be contrasted with the rather common occurrence of supernumerary gametophytes in *T. canadensis* (Dupler 1917).

The megaspore enlarges downwardly and laterally at the expense of the original sporogenous tissue, whose cells break down and finally disappear (fig. 7). No tapetum is formed; after the sporogenous cells are dissolved, the embryo-sac comes into contact with the ordinary vegetative cells of the nucellus and attacks them in the same manner. This localized growth of the gametophyte gives it the flask-shaped form (with a tentpole-like tip) shown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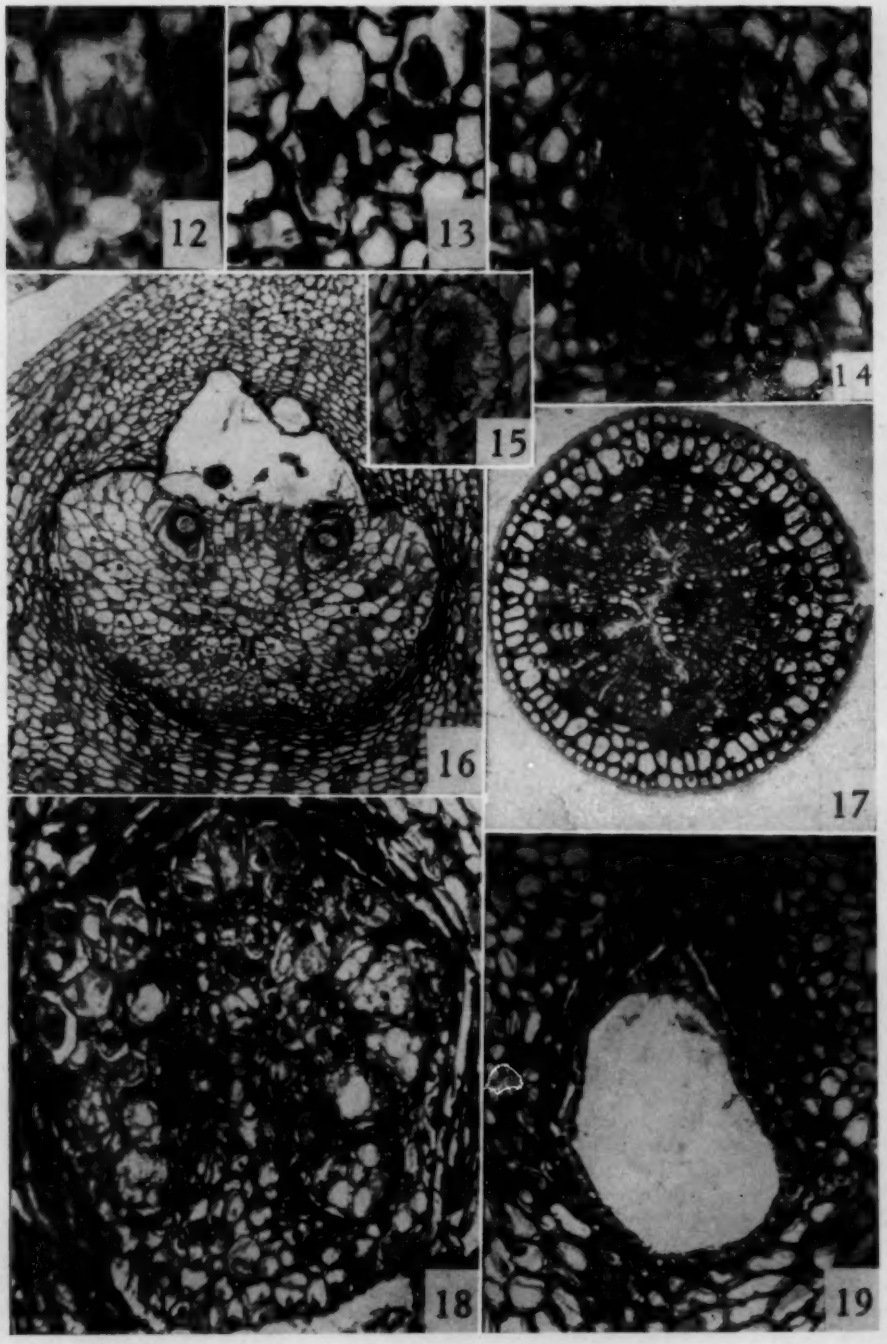
by Schacht (1850), Hofmeister (1862), Sokolowa (1891), Jäger (1899), Dupler (1917), and Saxton (1936). The same shape of the developing embryo-sac has also been described in *Torreya* (Coulter & Land 1905), *Cephalotaxus* (Sahni 1921), *Acmopyle* (Sahni 1920), *Austrotaxus* (Saxton 1934), *Saxegothaea* (Looby & Doyle 1939), and *Widdringtonia* (Saxton 1910). Sahni (1921) has commented at length on the parallel structure in the paleozoic Cordaitales.

The micropylar tip of the gametophyte does not enlarge at the expense of the surrounding tissues. Hence the original sporogenous area in this region is maintained as a deeply-staining, more or less inactive group of cells arranged as a hemispherical cap over the prothallus apex. (There are indications of occasional irregular divisions in the cells of this area.) The concentric arrangement of the nucellar tissue around this group is likewise maintained. When two gametophytes develop, however, the above-mentioned tissue is disintegrated by the growth of the second gametophyte. In this case, the prothalli are usually superposed, the one below behaving as it would if alone. The upper gametophyte, on the other hand, enlarges upwardly, so that its tentpole is directed toward the chalaza and its base toward the micropyle of the ovule (fig. 8).

As the embryo-sac enlarges, the nuclei divide, and numerous free nuclei are produced in the parietal layer of cytoplasm (figs. 1, 6–8, 20). The distribution of gametophytic nuclei often appears correlated with the principal direction of growth of the prothallus; these nuclei are grouped primarily at the enlarging end of the latter (figs. 6, 7). (When a gametophyte is growing upwardly, as when two are present, the nuclei occur at the expanding micropylar region of the upper sac; fig. 8.) It is also to be noted that the

Explanation of figures 1–11

Drawings made by microprojection. FIG. 1. Longisection of three megaspores, showing developing basal functional spore. Concentric divisions in nucellar cells about sporogenous group do not obscure origin of the cell groups in original longitudinal files. FIG. 2. Group of four megaspores in which second spore from chalazal end is functional. FIG. 3. Three megaspores in longisection. All three may be functional, but the basal one already shows a binucleate condition. FIG. 4. Third megaspore from chalazal end is seen enlarging here. The cell has already acquired a central vacuole while uninucleate. FIG. 5. Group of four megaspores, with third spore from chalazal end functional. FIG. 6. Two functional megagametophytes enlarging. FIG. 7. Embryo sac in longisection. Most of the nuclei and associated cytoplasm occur at the chalazal end of the sac, about which are disintegrated remains of nucellar cells. FIG. 8. Two developing embryo sacs with opposed tentpoles. At the chalazal tip of the upper sac appears to be a sterile spore. FIG. 9, a–d. Surface views of necks of mature archegonia, composed of two to four cells. FIG. 10. Megagametophyte in longisection after completion of alveolar development. Nuclei have moved to periphery in each alveole. Sac is indented on right by broadening pollen tube. FIG. 11. Tip of megagametophyte with mature archegonia and showing tentpole. Obliquely cut archegonium at left shows dense cytoplasmic condensation below central cell nucleus. Two branches of a pollen tube are visible over the shoulders of the gametophyte. All figures ×185. In all longisections, the micropylar end of the ovule is toward the top of the page.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parietal layer of cytoplasm is much thicker in this region of growth than elsewhere. Later, however, the distribution of nuclei and the thickness of the cytoplasmic layer tend to become more uniform (figs. 19, 20) and remain so through the stage of wall formation.

During the free-nuclear stage of prothallus development, there is present about the sac a very thin, tenuous, pliable megaspore membrane. This membrane is often so intimately associated with the surrounding tissue of the nucellus that it can be dissected out only with great difficulty in living material. The existence of such a membrane early in development has also been noted by Thomson (1905) and Dupler (1917). If the embryo-sac encounters no obstacles during the course of its growth in the free-nuclear condition, it is generally pear-shaped or somewhat spherical at the stage of wall formation, being surmounted by the nipple-like tentpole. Frequently, however, the prothallus is distorted during development by the pressure of the down-growing pollen tubes (figs. 10, 21). These have been observed to reach the embryo-sac at all stages of development, from the 4-nucleate condition to the time of archegonial maturity. The pressure of the pollen tube or tubes often indents the tentpole of the prothallial apex. Hence only half of the mature gametophytes may possess a tentpole even though that structure is present in most of the young embryo-sacs. Bizarre shapes are often thus produced by pollen tube indentations. In no case, however, is there an actual "erosive" effect of the tube on the prothallus, as claimed by Hofmeister (1862).

About the end of April, most megagametophytes have a large number of free parietal nuclei. As a rule, wall formation is initiated in the first week in May, when the embryo-sac has attained a transverse diameter of approximately 220 μ, when about 280 nuclei are present (fig. 19). This number of nuclei is calculated roughly by using the formula for the surface of a sphere ($4\pi r^2$). The figure given corresponds well with the one given

Explanation of figures 12–19

FIG. 12. Metaphase of first meiotic division of megaspore mother cell. ×666. FIG. 13. Longisection of two young pollen tubes, with the lightly-staining stalk nucleus shown moving down along the large body cell. The tube nucleus is at the base of the body cell in the pollen tube at the left and is just out of the plane of section in the one at the right. ×300. FIG. 14. Group of sporogenous cells in nucellus, showing darkly-staining cytoplasmic condensations. ×300. FIG. 15. Mature archegonium, cut obliquely, showing deeply-staining cytoplasmic configuration below central cell nucleus. ×150. FIG. 16. Longisection of megagametophyte with mature archegonia. Two unequal sperm cells have been formed, and the egg nuclei are central, surrounded by a dense cytoplasmic sheath. Note active cells at chalazal surface of prothallus. ×75. FIG. 17. Transection of integument in region of micropyle, showing closure following pollination. A definite cuticle appears in the commissure. ×75. FIG. 18. Transection of prothallus with numerous (at least 25) archegonia with alveolar cytoplasm. Some archegonia are surrounded by a definite layer of jacket cells. ×150. FIG. 19. Longisection of embryo sac with tentpole at time of wall initiation. ×150.

by Jäger (1899) and Dupler (1917). They report 256 nuclei before wall formation, on the basis of eight successive, simultaneous nuclear divisions. The latter figure can therefore be accepted in the present study.

As with other phases of megagametophyte development, there is a variation of over a month among prothalli in the date of wall inception. It is unnecessary to repeat in detail the pioneering description of Sokolowa (1891), which has since been confirmed by Dupler (1917). Jäger's (1899) description and figure gives an erroneous impression of this process and has been so criticized (Dupler 1917). Wall formation is obviously accomplished by means of undivided, ingrowing, tube-like alveoles, open at their inner ends (fig. 21). The alveolar walls form a honeycomb-like structure, in each hexagonal cell of which occurs one of the prothallial nuclei.

The nuclei advance inwardly at the actively growing ends of their respective alveoles. When the alveoles are closed, either by being cut off early by the intersection of other alveoles or ultimately by meeting opposed alveoles in the central line of the prothallus, the nuclei retire to the peripheral ends of the long prismatic cells (fig. 10). Then follows immediately the cutting up of each alveole into a file of smaller cells (all uninucleate) by successive mitoses, each mitosis being succeeded by wall formation (fig. 22). The alveolar origin of the cells of the gametophyte is long afterwards recognizable by the radial arrangement of many of the cell files (figs. 11, 16, 23).

The first-formed cells of the endosperm usually have large vacuoles, and their cytoplasm stains quite lightly (fig. 22). Subsequent divisions in the megagametophyte occur principally at the micropylar surface and, soon after, at the chalazal surface also. The cells of these regions soon acquire a greater nuclear : cytoplasmic ratio, smaller size, and deeper-staining quality than the remainder of the gametophytic cells. The micropylar zone, with its developing archegonial initials, is generally 3–5 cells deep over the surface of the prothallus (fig. 23).

Following archegonial initiation, mitotic activity in the endosperm cells appears to involve an increase in the number of cells within the original alveolar rows by many tangential divisions and not infrequent radial divisions (figs. 16, 22, 23). As the gametophyte enlarges, it expands at the expense of the basal and lateral nucellar tissue. At the same time, the enlargement of the archegonia at the apex of the prothallus has a widening effect. Hence at the time of fertilization, the gametophyte is often cordate, with the wider region above and an acutely tapering region below. As in *Podocarpus* (Coker 1902) and *Torreya* (Robertson 1904b), the endosperm cells on the expanding periphery of the lower part of the prothallus are smaller and stain more deeply than those more centrally situated (fig. 16).

No funnel-shaped archegonial cavity is formed above the archegonia by

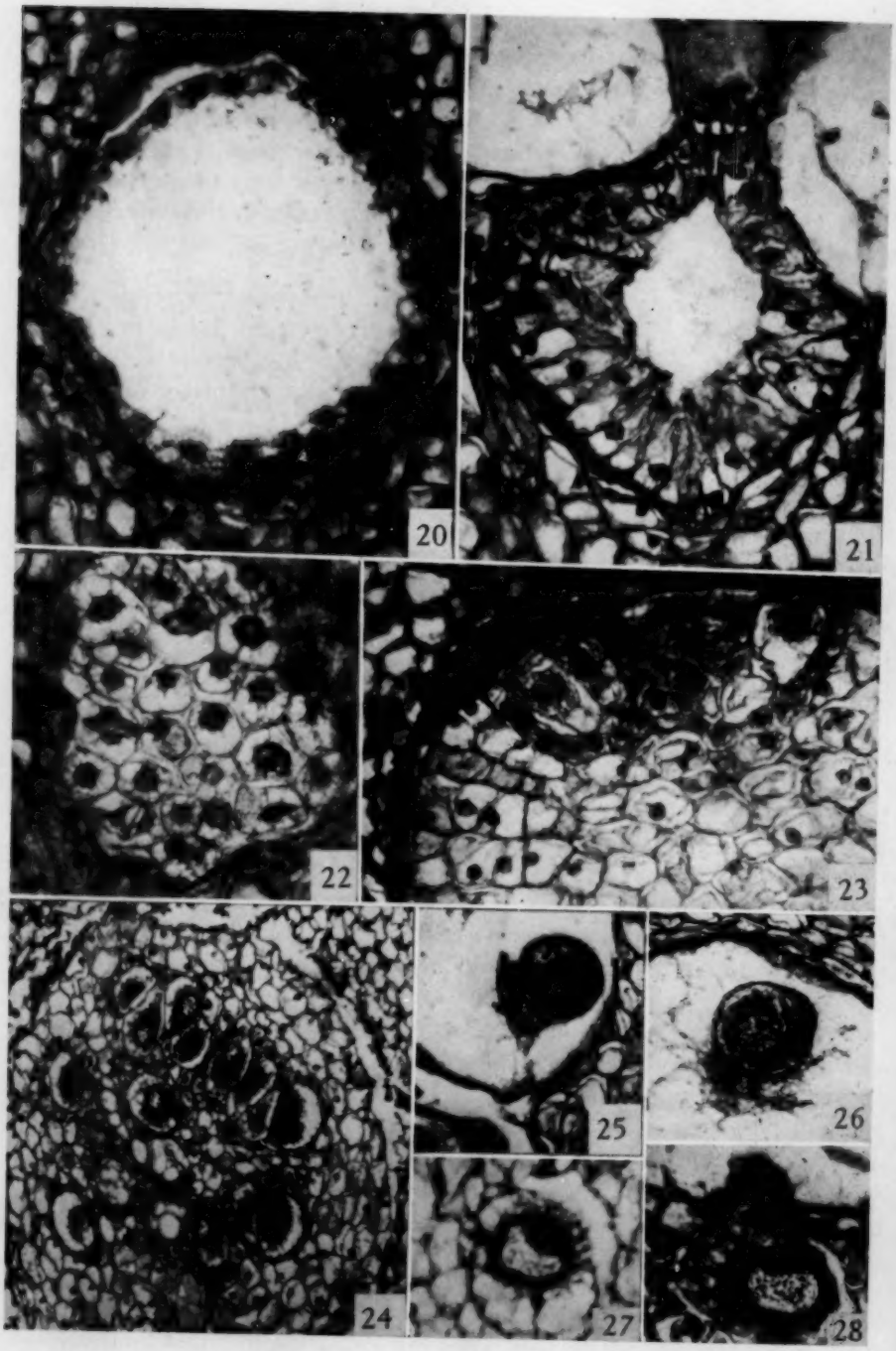
the endosperm cells before fertilization (fig. 16), although such a development appears normal in most conifers. However, this overgrowth of the archegonia by endosperm cells, to produce an archegonial chamber, has not been described for those conifers with lateral archegonia (sequoiads and callitroids). At the time of fertilization, the endosperm cells are all uninucleate, and the nuclei are strikingly variable in size. This size variation appears to be random and cannot superficially be correlated with differences in cell activity.

Archegonial Formation. The cells of the micropylar meristematic area divide principally in a plane parallel to the surface of the prothallus, *i.e.*, by repeated, active periclinal divisions. However, certain superficial cells in this region do not participate in the mitotic activity but gradually elongate as the zone extends in thickness (fig. 23). With enlarging vacuoles in their basal ends, these cells assume the role of archegonial initials. No initials extend to the center of the embryo-sac. If original alveoles are involved in their formation, as seems quite likely because of their shape, these are only those shorter alveoles which are cut off early by the intersection of neighboring ones.

Development appears to be simultaneous in all the initials. Each cuts off a neck-mother cell, which redivides to form from two to four neck cells arranged in a single tier at the apex of the archegonium (fig. 9, a–d). The central cell thus formed continues elongating and acquires an increasingly larger basal vacuole. Its nucleus remains near the neck, surrounded by a dense mass of cytoplasm, from which strands radiate out to the wall of the cell. Soon this nucleus also begins to enlarge in its position just under the neck, surmounting the large vacuole.

At the end of the period of archegonial enlargement (about mid-May) the growing nucleus of the central cell gradually begins to move down to the center of the archegonium. Just before this migration, the cytoplasmic contents of the archegonium undergo a striking series of changes. The cytoplasm in the upper part of the archegonium acquires larger vacuoles and becomes lighter-staining. In the meantime, the large vacuole in the lower end of the cell becomes invaded by cytoplasmic strands which break it up into a foam-like mass of cytoplasm and vacuoles (figs. 11, 18). In this way, the entire archegonium becomes uniformly foam-like, the vacuoles occurring as larger or smaller globules in a tenuous cytoplasmic reticulum. Soon a dense condensation appears temporarily below the central cell nucleus, extending in some cases to the base of the archegonium. This cytoplasmic condensation may be one continuous, deeply-staining strand, or it may assume a variety of peculiar forms (figs. 11, 15).

As the archegonium matures, its cytoplasm becomes gradually more granular and aggregated closely about the central cell nucleus, which becomes the functional egg nucleus. The deeply-staining localized condensation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disappears as the nucleus is surrounded by a densely granular sheath of cytoplasm, in which strands appear to radiate out from the nucleus into the less dense and lighter-staining areas of the cell (figs. 16, 24). In the mature archegonium, there are also spherical, deeply-staining bodies of various sizes irregularly scattered through the cytoplasm. These may be equivalent to the so-called "Hofmeister bodies" of the pinaceous egg cell. Some appear to be the size of nuclei of the endosperm cells, but they stain quite differently from the latter. The neck cells are present at maturity (figs. 9 a–d, 11).

At the time of fertilization, the enlarging egg nucleus has reached the center of the cell and attained a diameter of approximately 40 μ. Only three preparations seen in the present study give any indication of the possibility of the division of the central cell nucleus to form a discrete ventral canal nucleus and an egg nucleus. All other archegonia, which presented similar appearances, were seen to have the two nuclei separated by a very definite (although in some tenuous) membrane which extended completely across the archegonium. In view of the occasional occurrence of a ventral canal nucleus reported in *Torreya* (Robertson 1904b; Tahara 1940) and the possibility of its being formed in *Austrotaxus* (Saxton, 1934), it is possible to consider that the three archegonia observed had actually undergone division of the central cell nucleus. However, it should be mentioned that these archegonia were somewhat abnormal in that two of them appeared to lack a neck and the other showed a peculiarly incomplete separation of the two nuclei. Furthermore, it should be noted that no other investigator has found a ventral canal nucleus in *Taxus*.

Archegonial Distribution. As pointed out by Strasburger (1904), the archegonia tend to occur away from the central region of the prothallial apex (fig. 11). In dissected gametophytes, the archegonia are seen to occur most commonly in a wreath-like arrangement about the invagination produced by a pollen tube. The number of archegonial initials formed, as well as the number which finally matures, varies greatly. As few as 6 and as many as 25 or more archegonia (figs. 18, 24) were found in a gametophyte. The

Explanation of figures 20–28

FIG. 20. Longisection of embryo sac with free nuclei evenly distributed in parietal cytoplasmic layer about central vacuole just prior to wall initiation. ×231. FIG. 21. Inwardly growing alveoles of prothallus in median longisection. Two pollen tubes are indenting shoulders of sac. ×231. FIG. 22. Tangential longisection of embryo sac, with alveoles dividing up. ×231. FIG. 23. Portion of apical region of prothallus in median longisection. Archegonial initials are enlarging after having cut off neck mother cells. A jacket is present about several initials at left and another about the single initial at right. ×231. FIG. 24. Transection of prothallus with 18 mature archegonia. ×116. FIG. 25. Enlarged body cell with 2 sterile nuclei close by. ×231. FIG. 26. Two sperm cells with associated tube cytoplasm and one of the sterile nuclei. ×231. FIGS. 27, 28. Two cases of fertilization, showing indentation of egg nucleus by sperm nucleus. ×231.

usual number appears to vary between 8 and 14. Particularly of interest is the fact that in those prothalli with more than about 12 archegonia, there are many arrested initials, i.e., cuneate cells which have become vacuolate and have deeply-staining, relatively large nuclei. In these cases, all transitions could be found between ordinary "vegetative" prothallial cells and mature archegonia.

The jacket cells do not represent a step in this transition, although such a phenomenon is found in *Cryptomeria* (Arnoldi 1901; Lawson 1904b), *Sequoia* (Lawson 1904a; Buchholz 1939b; Looby & Doyle 1942), and *Sequoiadendron* (Buchholz 1939a; Looby & Doyle 1942). As reported by Schacht (1850), the jacket cells are not often differentiated. They are most obviously developed when but few large archegonia are present, seemingly confirming Lawson's (1940a) speculation that jacket cells are sterile archegonial initials and his inference (1904b) that the degree of jacket specialization is inversely correlated with the number of archegonia formed. However, jackets may be found in prothalli with very numerous archegonia (figs. 18, 24). Jacket cells in *Taxus cuspidata* are generally smaller than their neighbors, with usually a higher nuclear-cytoplasmic ratio. Nevertheless, their cytoplasm is not significantly denser than that of the neighboring endosperm cells. When differentiated, there is but a single layer of jacket cells about an archegonium or group of archegonia (figs. 16, 18, 23, 24).

The shape of the archegonia is also variable and appears to depend on their number and arrangement, as in *Pinus* (Ferguson 1904). When many are crowded together, they are usually elongated and narrow; when isolated from their neighbors, they may become nearly spherical. Some have been seen which appear to be bent at an oblique angle. If few archegonial initials are formed, they are all superficial in origin, and the necks of the archegonia are flush with the prothallus surface (fig. 16). With the advent of numerous initials, many archegonia have a hypodermal situation. Some are directly superposed in a radial line, presumably derived from a periclinal division in a primordial cell (fig. 23). Others may occur just below the surface layer of the gametophyte. These interior archegonia generally lack necks.

Commonly numerous archegonia are crowded closely together and appear to occur in tightly grouped complexes, with several archegonia in direct contact with their neighbors (figs. 18, 23, 24). In no case is the complex as well-developed as in members of the Cupressaceae. However, directly adjoining archegonia are so frequent in the Japanese yew as to appear as a rather constant character. In one instance, a gametophyte was found which had a definitely lateral complex of archegonia in addition to the normal apical group.

When secondary prothalli develop to maturity, archegonia may also be found in these. If the gametophytes are superposed, the archegonia appear

at the chalazal end of the upper one and, like the micropylar ones of the lower prothallus, directly abut on the pollen tube which grows between the gametophytes. In the one case in which two equally developed prothalli were juxtaposed, archegonia occurred at the micropylar end of each.

Microgametophyte Development. The history of the male gametophyte from pollination to fertilization is well known from the investigations of Strasburger (1892), Belajeff (1891), Jäger (1899), and Dupler (1917). Observations made on the development of the pollen tube during the present study agree quite closely with the data reported by these investigators.

The youngest tubes seen, several weeks after pollination, had already penetrated a little distance into the nucellus. The tube nucleus was near the tip of the pollen tube while the generative cell remained within the cavity of the grain. (Some tubes at this time had already reached the megaspore tetrad, as also reported by Coker in 1903.) After the division of the generative cell, the body cell and the stalk nucleus were found in the pollen tube close behind the tube nucleus (fig. 13). At this time, April 9, the embryo sacs were generally 2–8-nucleate, and the tubes had penetrated about a third of the distance from the nucellar apex to the female gametophyte.

The stalk nucleus apparently does not separate from the body cell but remains closely applied to it while the two are passing down the tube. The body cell is more or less conical, with its enlarging nucleus at the downwardly directed base. The stalk nucleus, at first at the distal vertex of the body cell, soon moves down along the latter (still closely applied to it; fig. 13) and eventually passes it. The stalk nucleus then moves to a position abreast the tube nucleus, both nuclei just ahead of the enlarging body cell. Most tubes were found in this condition about April 21. The two sterile nuclei, embedded in the abundant cytoplasm just behind the tip of the tube, very soon become alike in size and structure.

The complex of two sterile nuclei and body cell is situated near the growing end of the tube, generally about twice the distance of the tube diameter away from the tip. Up to this time, the tube diameter has been increasing only gradually. The body cell is found at the upper limit of the dense tube cytoplasm. Above this point, the tube lumen appears empty in sectioned material, but it is probably filled with vacuolar fluid in the living condition. The body cell then becomes more and more spherical, enlarging greatly all the time. Its cell membrane becomes more distinct and its cytoplasm exceedingly dense and very tenacious of stains, so that little structural detail is visible. The body cell nucleus occupies an eccentric position in the cell, generally located on the side of the cell diametrically opposite the position of the two sterile nuclei. Before marked tube expansion, the sterile nuclei are usually below the body cell, but in later stages, the relative positions of these may be greatly altered. Thus, the whole complex may revolve as

much as 180° about its horizontal axis, so that the sterile nuclei appear above the body cell. This condition has also been reported by Coulter (1897) and others.

On reaching the prothallus, the tip of the tube begins to widen rapidly and forms a sac-like expansion which may cover the entire prothallus apex. The body cell enlarges to about 60 μ in diameter, its cytoplasm becoming even more dense than previously and contrasting markedly with the lightly staining nucleus (fig. 25). Then the body cell divides into two quite unequal male cells, as has been described in detail by Belajeff (1891), Strasburger (1892), Jäger (1899), Robertson (1907), and Dupler (1917). Such a result of body cell division is also described for *Torreya* (Coulter & Land 1905; Robertson 1907) and *Podocarpus* (Looby & Doyle 1944, and others). The time of this division is variable: the body cell has been found already divided as early as May 12 and still undivided on June 2 and later (of the same year). The sperm cells become mature and are ready for fertilization. The previously dense cytoplasm at the tip of the tube has become vacuolated during the latter's expansion, and little cytoplasm surrounds the antheridial group. The sterile nuclei are still visible at sperm maturity (fig. 26).

Pollen Tube Development. Since the pollen tube is an integral part of the male gametophyte, its development is related to the functional behavior of the sex cells. However, ovules are often found in which the pollen tubes have produced sperm cells and no megagametophyte has been formed. As it moves down through the nucellus, the pollen tube slowly widens, sometimes twisting, meandering, and even branching. Just before reaching the embryo sac, the tube often branches once, sending a branch to each side of the sac's tentpole (fig. 11). These branches then expand greatly, either on the shoulders of the gametophyte or over its apex, often attaining a breadth equal to that of the prothallus itself.

When several tubes arrive at the embryo sac, they may "pile up" on each other, so that the sac-like expansions of successive tubes form a heap above the prothallial apex. The tubes may also, as described by Hofmeister (1862), Dupler (1917), and Saxton (1936), grow down the side of the gametophyte, in some cases meeting each other below the prothallus. The wall of the mature pollen tube is quite thick, as can be noted when shrinkage has taken place or when the wall has been dragged slightly in sectioning (fig. 16).

Fertilization. In concordance with the variability in gametophyte development, the time of fertilization extends over a month or more, with the first evidence of fertilization found on May 12. At maturity, the contents of the pollen tube are discharged almost completely into an archegonium. Rarely is any portion of the antheridial complex left behind in the tube. In fertilized eggs, it is often possible to detect three supernumerary nuclei

in the cytoplasm at the top of the egg, these being the two sterile nuclei and the non-functional sperm. In one case (fig. 28), a mass of cytoplasmic remains was found just outside the archegonium. It was not possible to determine the morphological nature of this mass.

When the tube contents have entered the egg cell, the functional sperm nucleus meets the egg nucleus in the center of the egg. This movement is probably rapid, since the cytoplasm above the uniting nuclei is filled with large vacuoles and presents a much disturbed appearance (fig. 28). The male nucleus sinks into the female (figs. 27, 28), and the two nuclei, with their boundaries still intact, usually move to the base of the egg. The male nucleus stains much more deeply than the female and appears to be filled with a dense concentration of granular material (figs. 27, 28). The egg nucleus is noticeably larger than the sperm nucleus.

In those eggs which are unfertilized, the female nucleus remains for some time in the center of the cell, large, lightly-staining, and surrounded by a cytoplasmic mantle. After a period of time, the nucleus begins to move downward toward the base of the egg, enlarging and becoming very irregular in outline during this passage. Evaginations at various points along the nuclear surface produce a pock-marked configuration at first. Eventually the nucleus loses its spherical form entirely as it assumes a variety of amoeboid shapes. The archegonium disintegrates completely soon after this stage. Subsequently it is overgrown and resorbed by the encroachment of the surrounding prothallial cells.

DISCUSSION

With reference to the general outline of gametophyte development, the present paper has served to corroborate most of the data previously presented. In the main, the gametophytes of *Taxus cuspidata* differ only slightly from those of *T. baccata*. The most significant differences shown by the Japanese yew are in the number and distribution of archegonia. In *T. baccata*, 5–11 archegonia occur (Gottsche 1845; Schacht 1850; Hofmeister 1862; Jäger 1899; Strasburger 1904); and in *T. canadensis*, 4–8 (Dupler 1917). In *T. cuspidata*, however, the archegonia are commonly very numerous, ranging from 6 to 25 or more in number. Robertson (1907) has noted an instance in *T. baccata*, in which there were up to 17 archegonia in a prothallus, but this record appears to be the only one of so many archegonia for that species.

Although Hofmeister (1862), Robertson (1907), and Dupler (1917) found that two archegonia in immediate contact were sufficiently rare to be remarked upon, Schacht (1850) showed 4 archegonia in direct contact in a row and noted that such complexes occurred as often as not in *T. baccata*. Likewise, Jäger (1899) described the archegonia as occurring in wreaths, bundles, rows, etc. In *T. cuspidata* the majority of gametophytes generally

shows a condition bordering upon a definite complex of archegonia. This may be somewhat comparable to the wreathlike arrangement described for *Cunninghamia* (Miyake 1910).

The occurrence of an occasional lateral group of archegonia in addition to the normal apical group is of doubtful phylogenetic significance in *Taxus*. Such lateral groups have also been reported in *Tetraclinis* (Juel 1904; Norén 1907; Saxton 1913b), *Fitzroya* (Doyle & Saxton 1933) and *Juniperus* (Hofmeister 1862; Norén 1907) on occasion. They have also been found abnormally in several other genera.

In the structure of the conifer megagametophyte, one of the most heavily weighted considerations in morphology is the organization of the archegonium. The Pinaceae are characterized by the formation of a ventral canal *cell*, which is separated from the egg cell by a definite membrane. In virtually all the other members of the Coniferales, the division of the central cell nucleus is not attended by cell wall formation, and the ventral canal nucleus lies free in the cytoplasm of the egg cell. In some specialized genera, the formation of even a ventral canal nucleus appears to have been suppressed. In these forms the central cell functions directly as the egg cell and the central cell nucleus as the egg nucleus.

Some investigators, however, have found the occasional formation of ventral canal nuclei (often in abnormal conditions) in these specialized genera. Robertson (1904b) and Tahara (1940) have found them in two species of *Torreya*. Similarly Saxton has described the formation of a ventral canal nucleus in *Widdringtonia* (1910) and its abnormal occurrence in *Actinostrobus* (1913a). In the present investigation, the occasional division of the central cell nucleus is regarded as abnormal in *Taxus cuspidata*.

The Taxaceae exhibit an interesting contrast to the other conifers, particularly the Pinaceae, in the overall period of megagametophyte development. Whereas the pine gametophyte is generally full-sized or nearly so at fertilization, the taxoid prothallus is relatively quite small when compared to its size at maturity. The major part of endosperm growth occurs subsequent to fertilization in *Taxus* and *Torreya*. In *Taxus*, the whole embryology, from megaspore formation to seed maturity, takes place within the space of a single season.

The organization of the reproductive structures in *Taxus* has often been discussed with reference to its relative antiquity or modernity. With regard to the organization of the gametophytes of this genus, there seems to be but little doubt that "advanced" features predominae. Thus, the pollen grains are uninucleate and produce no prothallial cells. The organization of but a single functional sperm cell, formation of archegonia in a near-complex, and suppression of ventral canal nucleus formation are likewise features of specialization. The phylogenetic significance of the number of archegonia,

number of germinating megaspores, and degree of jacket cell differentiation is doubtful. Too little is known of primitive conifers to evaluate these characteristics, any of which may be a cenogenetic rather than palingenetic phenomenon.

SUMMARY

Gametophyte development in *Taxus cuspidata* is described from sectioned material and whole mounts. The chronology of development is variable, and some phases may be found during a period of almost two months in different ovules on the same plant. Megagametophyte development follows the production of a linear row of three or four spores from a single mother cell embedded in the midst of a group of similar cells—a sporogenous group. About five per cent of the ovules contained two developing embryo sacs; none contained more than two.

The early free-nuclear stage of prothallus development is characterized by the assumption of a flask-shaped form of the sac and the aggregation of most of the nuclei and cytoplasm at its basal, growing end. A tapetum is absent in this growth. Wall formation is initiated at the stage of about 256 free nuclei and proceeds by means of open, ingrowing alveoles. From 6 to over 25 archegonia may be formed, many closely grouped into complexes. Jacket cell differentiation is usually indefinite, and a ventral canal nucleus is rarely, if ever, formed.

Pollen tube and male gametophyte development are as reported for other species of *Taxus*. Fertilization is briefly described, including the usual entry of all the tube contents into an archegonium and copulation of the two unequal-sized sexual nuclei in the center of the archegonium.

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CITATION OF BOTANICAL REFERENCES

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In 1893 the botanical congress assembled at Madison, Wisconsin, adopted "rules for citation," in the hope that they would become universal among botanists. This was an attempt to bring order into chaos. Measured by the criteria of simplicity and clarity, they are good rules and merit more general acceptance.[1]

If one examines the periodical literature of botany of the early years of this century, one finds the utmost heterogeneity in this matter of citation. Not only did one periodical differ from another, but even within the covers of one volume, of one issue, even in the "literature cited" on one page, there was no standard, no system. A recent writer[2] has expressed approval of this sort of thing by poking fun at modern editors who insist upon consistency. But I doubt whether the (anonymous) author would himself like to be seen in socks of different colors, though they would suit his purpose as well. And it is easy to show that heterogeneity of citation, besides conveying an appearance of slovenliness, actually invites error. The need for uniformity within one periodical in this respect is now generally recognized; the reasons are the same for general uniformity within the science. Such uniformity would be especially to the advantage of the taxonomist, who deals with a multiplicity of complex references, in which accuracy is vital to his peculiar concerns. Other varieties of botanists, however, would benefit almost as greatly; for it is of small use to adduce the facts and opinions of others in your work if you do not state concisely and accurately where that work is to be found. The purpose of the present note is to substantiate these contentions and to urge the general adoption of the Madison "rules for citation," with certain modifications which experience has shown to be desirable.

The diversity of which I am speaking is seen principally in methods of abbreviating (or not abbreviating) words, in the symbols used for series, volumes, parts, and pages, in the characters used for designating the numbers of the same, and in punctuation. Compare the following:

Quart. Journ. Micr. Sci., New Ser., vol. xxv, 1895.
Ann. of Bot., vol. x, 1896.
Ann. Sci. Nat., Bot., 9e sér. t. ix, 1909.
Bot. Zeit., vol. xxxix, 1881, pp. 329–336.
Prings. Jahrb. f. wiss. Bot., Bd. liv, 1915.

[1] They were printed in Bull. Torrey Club **22**: 130–132 (1895).
[2] See Am. Scientist **35**[3].

These were all taken from one volume of one periodical. Notice that prepositions are sometimes included, sometimes omitted: "Ann. of Bot." but not "Ann. des Sci. Nat." Volumes are sometimes "vol.," sometimes "t." or "Bd.," more or less in accord with the country of origin, but not consistently so (compare the last two citations). A general rash of periods and commas probably betrays a deficiency of nourishing principles. With all the apparatus of citation, clumsy and untidy as it is, page numbers are given in only one of the above references. Here are some more, from various sources:

Compt. rend., 172, 99, pp. 1306–9, 1921.
Vidensk. Medd. Kjobnhavn, 1877, p. 736.
Ber. Botan. Gesellsch. vol. xxvi. p. 468.
Jourd. & Fourr. Icon. Fl. Eur. i. 6. iv. fig. 13 (1866).
Rabh. Krypt.-Fl. Deutschl. ix. iv. I. 145 (1933).
Ann. d. Chem., t. CCCLXXXVI.
Gard. Chron. Ser. III., LXXXVII. 431 (1925).
Fl. lusit. et. brasil. spec. (1788) 1 t. 1 f. 1.
Jacq. Ic. i. 2. t. 13.
Sol. 1. c. lii. 654, 6. 20 (1762).
Rec. d. trav. bot. néerl. 29, S. 497, 1932.
C. R. Ac. des. Sc. T. 211, 1940, p. 359.
Cbl. f. Bakt. I, 24: 11–12.
Bot. Mag. LXXXVIII (1862) t. 5339.

It is evident, first, that most of the commas and many of the periods have nothing to do in these citations. Punctuation is like government, the less you have the better off you are, providing you have enough to maintain order.[3] The period that serves as a sign of abbreviation ("Sci.") can also separate the words, and no comma is necessary before the following word or number. To those who use the Madison rules the citation "Ann. Sci. Nat. Bot. IX. **9**" is clear and concise.[4] Such a citation, provided that all are using the same code, needs no "v." or "vol." or "t." or any other encumbrance to make it clear that the following number is that of a volume; the same applies to "ser." and to "pp." and the like. These symbols have, indeed, largely become obsolete; but without general agreement confusion may result. Notice the fifth citation in the last group above; could any one go at once to the shelf and reach down the right volume of this work? In short, that brevity which is the soul of accuracy depends upon uniformity. The Madison rules provide that the series (if any) be designated by Roman capitals followed by a period, the volume by an Arabic numeral in boldface type, and the part (if it is necessary to cite it because of independent paging)

[3] The same principle holds good for references in an article to a "literature list" at the end: in a review of literature "(Smith 1948)" needs no comma between author and date.

[4] The word "Bot." (for "Botanique") can also be omitted in an exclusively botanical work.

by an index (superscript) number. The number of the volume is followed by a colon, and this in turn by the numbers of the pages.

The dangers of Roman numerals used freely are evident, especially in "lower case"; a certain reference to "v. 16" long eluded me because I thought it meant "volume 16" instead of "volume 5 page 16." "ic." and "l.c." are easily misread. The eight Roman capitals of the last citation above offer that many chances for error as compared with the two of "**88**"; perhaps we should be grateful that the plate number which follows was not similarly designated.

The symbols for designation of illustrations are a special problem; here one must use some device to make it clear that the numbers do *not* refer to pages. There is a wide choice of available signs: Pl., pl., Taf., Tab., t., fig., f., text-fig., Textabb. "t." is easily confused with "tome" (notice the sixth citation in the second group above). "Taf." and "Tab." are used also for "tables." "Text-fig." refers to a distinction no longer so familiar as formerly because of changes in methods of production. The "*pl.*" and "*f.*" prescribed by the Madison rules are as simple as any, and probably generally understandable; the most valuable feature is the use of italic in citing illustrations, which at once differentiates them from the rest of the citation.

As for abbreviations, the principles laid down (and not always followed) in the *International rules of botanical nomenclature*, ed. 3, Rec. XXX, for the abbreviation of authors' names serve admirably for the abbreviation of titles also. The reader of the present note can easily select from the examples given words and titles which are unnecessarily long ("Gesellsch." where "Ges." is sufficient) and those which are unduly abbreviated ("Cbl." for Centralblatt. Uniform capitalization makes for easier reading. Prepositions are usually unnecessary ("d.", "f.", "of" in the examples). Since a brief discussion of abbreviation has been published elsewhere,[5] it need not occupy space here.

While it is perhaps undesirable and probably impossible to promulgate and adopt an index of all abbreviations of authors' names and of titles,[6] it would not be difficult to establish, in one of the larger botanical libraries, a central bibliographic clearing-house where the *International rules* might be edited for uniformity of citation. Without great expense a catalogue could be formed of all authors and titles cited, new titles being added as they occurred in successive editions; by reference to this, citation of authors' names and of titles could be made and kept uniform. All references, moreover, could readily be compared with the original sources, and accuracy

[5] Bull. Torrey Club **74**: 348. 1947.

[6] Such an index was proposed at the Madison Congress; see Proc. Madison Bot. Cong. 45 (1894).

would be gained at the same time as consistency. In one list of names printed in the present *Rules* a well known work is referred to as "L. Spec. pl."; in another it is "L. Sp. Pl." Among the rejected names for genus 4090 we read "Chalcas L., Mant. I (1767) 68" and "Bergera Koenig ex Linné, Mant. II. (1771) 555"; this is all one work, continuously paged; the Roman numerals are superfluous; and, as far as I know, all is by the same Linnaeus. "Periloba Rafin.," "Toxylon Raf.," "Adlumia Rafin.," and "Quamasia Raf." were all described by the same man. *Pentagonia* Benth. has been proposed for conservation against *Pentagonia* "Heist. ex Fabricius, Enum. Pl. Helmstad." This is presumably the same work as "Fabr., Enum. pl. Hort. helmstad" and "Fabricius, Enum. Pl. Hort. Helmst." of the *Rules*. Such diversity has arisen obviously through the contribution of proposals from many sources; this is one argument the more for the necessity of proper editing in a permanent headquarters. The abbreviation "Schlecht." or perhaps "Schlechtend." is preferable to "Schlechtd.," not to mention "Schltd."; and "Hpe." is certainly not a clear abbreviation, even if perhaps it has been in "general" use. On the other hand, Engler and Prantl certainly need not be spelled out, and might well be abbreviated (as in many American works) "E. & P.," being almost as well known as Linnaeus. Torrey and Gray are sufficiently clearly indicated by the now customary "T. & G." instead of by "Torr. et Gray" and the several other versions found in current lists of nomina conservanda. In general, such lack of system should not be permitted in a document pretending to be an instrument of clarity and precision. Nor is this only a matter of appearances. In referring to two volumes of the *American monthly magazine* the years are used instead of volume numbers: 1817 and 1818. But volume 1 and part of 2 appeared in 1817, the rest of 2, 3, and part of 4 in 1818; for the first citation one must look in two volumes, and for the second in three—only to find that the name in question appeared in 1819. This name is given as "Joxylon Raf.," though it was printed "Ioxylon" in the first reference and corrected to "Toxylon" ("bow-wood," a common local name) in the second. All this comedy of errors could have been avoided by such a procedure as I have outlined.

To measure the acceptance of the Madison rules, a survey of 32 periodicals in five languages was made with reference to the numerals used for volume numbers. The results were as follows:

	Roman		Arabic		No consistent
	lower case	capital	boldface	plain	practice
U.S.A.	1	...	5	2	1
German	...	1	7	...	1
French	...	1	1	...	2
English	4	3	2	...	...
Swedish	...	...	...	...	1
	5	5	15	2	5

The trend towards the Madison rules was measured by comparing older and more recent issues of the same periodicals; these had changed from Roman numerals to Arabic boldface as follows: 1 in U. S. A, 3 in Germany, 2 in France, 1 in England; none had made the reverse change. It is clear that the advocates of the older system have only an irrational conservatism to advance in the face of general practice.

In conclusion, it is obviously desirable (as it was in 1893) to adopt a uniform system for botanical references, and that formulated at Madison has been fairly generally used and has stood the test of time. It should be given international authority by re-enaction by the next Congress. Some modifications, however, seem desirable.

(1) The use of brackets for certain particulars—as in "[6th ed.]"—may be unnecessary. The edition number is to be treated as a part of the title. The word "*illust.*" is equivalent to any other statement of illustrations, and should be so treated.

(2) It may be well to designate, at least sometimes, parts of a volume by numbers in parentheses instead of by superscript numbers. This has an advantage for volumes which are subdivided more than once—having parts within parts.

(3) The place of the date need not be rigidly specified, and it may be desirable in some references to enclose the date within parentheses so as not to disturb the continuity of a sentence. Citation of the year of publication is one of the few things that offer no difficulty; no one seems to have found it worth while to disguise it. Citation of day and month should conform to the method prescribed by the Madison rules.

(4) The distinction between volumes and other divisions of a series, to be signalized by the use of boldface or plain type respectively, is questionable. There is no available definition of what constitutes a volume. It may mean a principal division of the work irrespective of pagination or of physical composition; it may refer simply to binding ("Band"). Michaux' *Flora boreali-americana* consists of two "tomes" paged separately but often bound together: two volumes in one sense, one in the other. De Candolle's *Flore française* has five "tomes" but six "volumes," the fourth "tome" being divided into two "parties" and the sixth volume being designated as "tome cinquième, ou sixième volume." *Das Pflanzenreich* has a dual system. It was issued in "Hefte" which were not numbered in taxonomic order; the whole series was numbered also in four parts, and the families numbered within the parts. The main parts of this work may be said to correspond, for practical purposes, to the volumes of other serial publications, being the primary divisions; the separate issues ("Hefte") need not be cited, and, indeed, cannot be unless their covers were saved. *Heft 23* may best be cited, for instance, as **4**^{225}. *Tropical woods* is issued in parts, with no indication

of larger units; for such parts the boldface numeral seems appropriate and useful. On the other hand many "bulletins," though consecutively numbered, are gathered into volumes, and the numbers of the latter must obviously be treated as primary.

In general, the changes I suggest are such as to render the rules less strict and therefore easier to apply. Consistency and clarity can be attained even more certainly by modification in this direction. The authorization of a greater degree of freedom in the application of the rules is not to be interpreted as a return to irresponsibility (once established for any particular work, usage should be followed with precision), but as recognition of the part that intelligence should play in the use of any rules.

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CITATION OF AUTHORS' NAMES IN TAXONOMY

H. W. RICKETT

In the *International rules of botanical nomenclature,* ed. 3, under the general heading "Citation of authors' names for purposes of precision," we find the following article.

> Art. 48. When a name of a taxonomic group has been proposed but not published by one author, and is subsequently published and ascribed to him (or her) by another author who supplied the description, the name of the latter author must be appended to the citation with the connecting word *ex*. The same holds for names of garden origin cited as "Hort."
>
> If it is desirable or necessary to abbreviate such a citation, the name of the publishing author, being the most important, must be retained.
>
> Where a name and description by one author are published by another author, the word *apud* is used to connect the names of the two authors, except where the name of the second author forms part of the title of a book or periodical, in which case the connecting word *in* is used instead.

To attempt to make such distinctions between citations, by using different prepositions, may be to adduce information for which we have no evidence. When a name is published by Torrey and Gray and by them ascribed to Nuttall, it is often impossible to say whether the latter supplied the name and description or the name only. The difficulty in applying this provision is well seen in two citations which occur within a few lines in the list of nomina conservanda: "*Nomochloa* Beauv. ex Lestib. Ess. Fam. Cypérac. (1819) . . ." and "*Heleophylax* Beauv. in Lestiboudois, Essai fam. Cypér. (1819). . . ." In one line it is stated that Beauvois proposed the name *Nomochloa* and that Lestiboudois supplied the description; in the other that he furnished both name and description of *Heleophylax*. In spite of the diversity of abbreviations, both citations are from the same work, and no evidence for such a distinction appears in this work.

As an example to illustrate the use of *in* the following is given: "*Viburnum ternatum* Rehder (in Sargent, Trees and Shrubs, II . . .) . . . in this latter example the second author's name, Sargent, forms part of the title of a book." This is manifestly incorrect. On the title-page of the book in question we read: "Trees and shrubs. Illustrations of new or little known ligneous plants. . . . Edited by Charles Sprague Sargent." The name of the "editor" certainly forms no part of the "title." What was presumably meant was that it is necessary to use Sargent's name in specifying the work; one cannot refer to "Trees and shrubs" as one can to "Botanical Gazette," simply by volume and page. Here a certain confusion enters. Is the name of the editor or author of the work cited as being one of the "authorities" of the name published therein? Or is his name inserted merely as a bibliographic con-

venience, a means of specifying the work? So it may be necessary to use the name of the editor in referring to a periodical; e.g., Hooker's *Icones plantarum,* Desvaux' *Journal de botanique,* to distinguish these from other *Icones plantarum,* other *Journaux de botanique.* But in such cases the editor's name is merely a conventional symbol, one among the several used in specifying a certain periodical, and he is not regarded as responsible for names published in its pages. Engler's name was formerly generally prefixed to the *Botanische Jahrbücher* which he founded and for many years edited; this is actually no more necessary than it is to use Coulter's name in referring to the *Botanical gazette.* Are we to insert the preposition *in* if Engler's or Coulter's name is used in designating the periodical, and omit it otherwise? Such a procedure adds complexity without any possible gain to our citations. It would be as useful and appropriate to cite the name of all editors of botanical periodicals for the names which appear under their supervision.

The intent of the article is certainly that the "second author" is really the author of the pages in question, who provides space otherwise occupied by his own writing to the name and description furnished by another. To signalize this relationship by means of a special preposition is of doubtful usefulness. Furthermore, due regard should be shown for known facts in joining the names of authors. It is unnecessary to ascribe *Securigera* to "DC. in: Lamarck et De Candolle, Fl. Franç. ed. 3 . . ." since it is well known that de Candolle was the author of this edition and the work is sufficiently identified as "DC. Fl. Fr." Again, new names which appeared in Sowerby's *English botany* are ascribed to J. E. Smith, the author of the text. Instead of writing "Smith in: Sowerby, Engl. Bot." it is conducive to clarity and to economy of space to write simply "Smith, Engl. Bot." Perhaps the reductio ad absurdum of botanical citation is seen in such examples as "*Andreoskia* DC. in DC. Prodr. I (1824) 190." It is obvious that here only one author is cited (as was true also in the previous examples), and no preposition is necessary to connect his name with itself.

To sum up: It is frequently impossible to determine which of the prepositions *ex, apud* or *in* should be used as prescribed in Art. 48. When an author's and particularly an editor's name is used merely to identify a work of periodical, the use of a special preposition is meaningless; methods of citation, having regard to clarity and brevity, shouly follow the same principles for such works and periodicals as for others. Redundant citation of "authorities" that are not so in fact should be avoided.

The second paragraph of the article is never followed. If a writer does not cite "*Peucedanum salmoniflorum* Coult. & Rose ex Holzinger," he writes simply "*Peucedanum salmoniflorum* Coult. & Rose," and that is literally the end of it. It is of no use to write provisions into the *Rules* that cannot be

enforced, however desirable in theory. The point is that citation of authorities in itself is of small bibliographic importance, since it carries no information on the place of publication. It does add "precision," so that we need not confuse *Benthamia* Richard with *Benthamia* Lindley; besides giving that credit for taxonomic discovery which is dear to the hearts of its practitioners.

In conformity with the foregoing conclusions, Article 48 should be changed to read as follows:

> Art. 48. When a name of a taxonomic group has been proposed but not published by one author, and is subsequently validly published and ascribed to him by a second author, the names of both authors should be cited. The same holds for names of garden origin cited as "Hort."
>
> A semicolon may be placed between the names of the two authors; or a preposition may be used instead to convey more definite information on their relative contributions. For this purpose *ex* indicates that the second author supplied the description associated with the name proposed by the first author; *in* should be used only if an author (or editor) whose name appears on the title page of a book includes in his pages names and descriptions of another author, properly ascribed to the latter; *apud* may be used for a similar relationship when publication is effected in an article in a periodical.
>
> Examples: *Centropogon coccineus* Regel ex F. E. Wimmer, Ann. Naturh. Mus. Wien **46**: 421. *Lobelia pectinata* Engelm.; Wisliz. Tour N. Mex. 108. *Sium pusillum* Nutt.; T. & G. Fl. N. Am. **1**: 611. *Teucrium charidemi* Sandwith apud Lacaita, Cavanillesia **3**: 38. *Viburnum ternatum* Rehder in Sargent, Trees & Shrubs **2**: 37.

Recommendation XXXII quater, adopted at the Congress in Amsterdam in 1935, still further complicates procedure. It reads: "In citation of literature 'in' should be inserted after the name of the author if the citation refers to a periodical or other serial publication, or if it is a work by another author." The second part of this merely duplicates part of Art. 48, in providing for the insertion of *in* before the name of the "second author"; in fact, one of the examples adduced for the Recommendation is actually drawn from the same work as that used to exemplify the Article, Sargent's *Trees and shrubs*. As for the first part of the Recommendation, in providing for the general use of "in" in all citation of periodical literature, it renders meaningless most attempts to conform to the Article. When we write "*Cyathea cunnighami* Hook f. in Hook. Ic. **54**: *pl. 985*," do we insert the preposition because the name was "published" by W. J. Hooker for J. D. Hooker, who furnished the description, the elder Hooker's name being "part of the title" of the periodical; or simply because it appeared in a periodical? Obviously, if we are to use *in* for *all* references to periodicals, it is silly to specify its use for *certain* periodicals. Actually to adopt this Recommendation would be to add unnecessary complexity without gain. The Recommendation (now in its period of probation) should be rejected at the next Congress.

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SOME NEW OR INTERESTING FUNGI

M. J. THIRUMALACHAR

An Undescribed Leaf Parasite of Cycas. *Cycas circinalis* and *C. revoluta* are commonly planted in the gardens in South India for their foliage. In the months from September to February, a leaf disease caused by a species of *Arthrobotryum* was noticed in many places. The infection spots appear as irregular orange-yellow specks on the dorsal surface of the leaf. On the lower surface sooty-black spots are formed by the aggregation of a number of coremia. The mycelium is intercellular and slightly dark in color. The synnema is formed by the closely interwoven mass of hyphae emerging from the stoma. The entire synnema is obconical and bears on the apical half numerous conidiophores, on which 3–4-celled conidia are borne acrogenously. The mature spores are 3–4-celled, yellowish-brown, cylindric, rounded at both ends, slightly constricted at the septa and measure 25–31 × 7.5 × 12 μ. The epispore is minutely and closely warty. The present species is distinct from other species of *Arthrobotryum* recorded on other phanerogamic hosts as well as parasites on *Meliola*.

Arthrobotryum Cycadicola Thirumalachar, sp. nov. Infectionis maculae luteae, irregulares, 2–4 mm. diam. Synnemata hypophylla, nigra, 70–100 μ alta, 40–71 μ lata ad basim 144–180 μ lata ad apicem et consequenter obconica. Conidiophori simplices, clavati; conidiis terminalibus, conidia cylindrica, luteo-brunnea, fuliginosa si plura aggregentur, rotunda in utroque apice, 2–4-septata, constricta ad septa, magnitudinis 25–31 × 7.5–12 μ; episporio dense operto minutis atque obtusis verrucis.

Infection spots yellow, irregular, 2–4 mm. in diam. Synnemata hypophyllous, black, 70–100 μ high, 40–71 μ wide at the base and 144–180 μ at the apex and thus being obconical. Conidiophores simple, clavate with terminal conidia; conidia cylindric, yellowish-brown with a sooty appearance in mass, rounded at both ends, 2 to 4-septate, constricted at the septa and measuring 25–31 × 7.5–12 μ, epispore densely covered with minute and blunt warts.

Hab. on the pinnae of *Cycas circinalis* L. leg. M. J. Thirumalachar, Bangalore, South India, 24–10–1945 (TYPE). Type deposited in the Herb. Crypt. Ind. Orient., New Delhi, India, and in the Herbarium, I.M.I., Kew, England.

SEPTORIA CYNODONTIS Fuckel. Symb. Myc. 389. Sacc. Syll. Fung. **3**: 562. On the leaves and sheaths of *Cynodon dactylon* Pers. Bangalore, India, 13–10–1945.

The infection appears as long, thin striae on the upper surface of the leaves.

SEPTORIA SWERTIAE Pat. Rev. Mycol. 181. 1886; Sacc. Syll. Fung. **10**: 376.

A *Septoria* species was collected near Kemmangundi, Mysore State (India), on the leaves of *Swertia* sp. which agreed very well with *Septoria*

Swertiae described by Patouillard from material collected in China. The infection spots were epiphyllous, brownish-black, bearing numerous pycnidia. The mature pycnidia are 57–71 μ in diam. with numerous hyaline, acicular 1-septate spores. Rarely some of the spores are 2-septate.

During a study of the pycnidia, the association of the perithecia of a *Leptosphaeria* was noticed in numerous cases. These were produced from the same mycelium which bear the pycnidia, and it became evident that the two belong to the same fungus. Since *Septoria Swertiae* is not known in its perfect stage and the type material is not available for comparison, it is not possible to determine whether the *Leptosphaeria* stage observed in the present study would constitute the perithecial stage of Patouillard's fungus. Since no similar species of *Leptosphaeria* has been reported on species of *Swertia*, the name **Leptosphaeria Swertiae** is tentatively proposed for the accommodation of the fungus.

The perithecia are epiphyllous, closely associated with the pycnidia, flask-shaped, yellowish-black, subepidermal, erumpent, and ostiolate. Asci cylindric, 42–46 × 7–11.5 μ, paraphysate, paraphyses simple and filiform, about the same length as the asci, 8-spored; ascospores, 1–2–seriate, cinnamon-yellow, fusoid, 6–7–septate, not constricted at the septa and measuring 16–20 × 4–4.5 μ.

On the leaves of *Swertia* sp. Kemmangundi, leg. H. C. Govindu, 12–8–1945. (S. India.)

PHYLLOSTICTA on *Epichloe cinerea* Berk. & Br. *Epichloe cinerea* Berk & Br. in a common parasite on the inflorescences of *Eragrostis pilosa* Beauv. round about Bangalore (S. India). As a result of infection the inflorescence becomes transformed into a clavate to cylindric stroma 4–5'' long with numerous perithecia embedded in it. A species of *Phyllosticta* was found growing on these stroma in large numbers. The hyphae appeared to penetrate into the stromatic tissue and the ostioles were occluded by the mycelial strands of the *Phyllosticta*. Many of the perithecia were without asci and ascospores. Some of these observations indicated that the *Phyllosticta* sp. might be parasitic but more evidences are required to confirm the parasitic behaviour. *Agerita Pezizoides* (Cda) Bon. and *Botrytis Epichloes* Ell. & Dearn. have been recorded in literature as being hyperparasitic on the stroma of *Epichloe*. The *Phyllosticta* species noticed was exclusively confined to the stroma without attacking *Eragrostis*. As no other species of *Phyllosticta* has been recorded on *Epichloe* or related forms the present one is proposed as a new species.

Phyllosticta Epichloes Thirumalachar, sp. nov. Pycnidia globosa, superficialia, hyphis intertexis, ostiolata, 37–55 × 37–70 μ, nigra. Sporae ovatae, hyalinae, 4–5.5 × 2.5 μ. Conidiophori simplices, breves, erecti atque hyalini.

Pycnidia globose, superficial with interwoven hyphae, ostiolate, 37–55 × 37–70 μ, black. Spores ovate, hyaline, 4–5.5 × 2.5 μ. Conidiophores simple, short, erect, and hyaline.

On the stroma of *Epichloe cinerea* Berk & Br., leg. M. J. Thirumalachar, Bangalore, 18–11–1944, TYPE, deposited in Herb. Crypt. Ind. Orient., New Delhi, and in Herb. I.M.I., Kew, England.

GLOESPORIUM PALMARUM Oud. Contr. Myc. Pays-bas. **14**: 48. Sacc. Syll. Fung. 11: 567.

On young leaves of *Areca catechu* L., Mysore, S. India, leg. M. J. Thirumalachar, 4–4–1945. The fungus also causes sometimes lesions on young nuts and portions of the inflorescence. The acervuli are numerous with one-celled spores which measure 17–20 × 5–6 μ. It agrees well with the descriptions of *Gloeosporium palmarum* Oud. on *Areca sapida*. A *Gloeosporium* sp. has been recorded by Thomas (Administr. Rep. Gov. Mycol. Madras, **1936–37**. pp. 17) for South India.

A Cylindrosporium Leaf Blotch of Curry Leaf. *Murraya Koenigii* Spr., popularly known as the curry leaf tree is widely grown in S. India for its leaves which are used for culinary purposes. A leaf blotch disease incited by a species of *Cylindrosporium* has been found to do some damage. The blemishes deteriorate the quality and reduce the market value of the leaves.

The acervuli of the fungus are epiphyllous, subepidermal, and erumpent, producing numerous acicular conidia in mass. Mature conidia are hyaline multiseptate and measure 50–80 × 3.5–6 μ.

Cylindrosporium Koenigii Thirumalachar, sp. nov. Infectionis maculae albidae, epiphyllae, circulares vel irregulares, 3–10 mm. diam. tenuiter elevatae, anthracis maculis similes; acervuli subepidermales, erumpentes, confluentes atque continui evadentes; conidiophori clavati, cylindraci, hyalini, simplies, 44–56 × 3.5–4.5 μ, acrogene producentes conidia, fusiformia; conidia hyalina, multiseptata, attenuata in apice, haud constricta ad septa, magnitudinis 50–80 × 3.5–6 μ.

Infection spots whitish, epiphyllous, circular to irregular, 3 to 10 mm. diam., slightly raised and appearing as anthracnose patches; acervulus subepidermal, erumpent, confluent and becoming continuous; conidiophores clavate cylindric, hyaline, simple, 44–56 × 3.5–4.5 μ, developing acrogenously acicular to fusiform conidia; conidia hyaline, multiseptate, tapering at the apex, not constricted at the septa, and measuring 50–80 × 3.5–6 μ.

On the leaves of *Murraya Koenigii* Spr., leg. M. J. Thirumalachar, Bangalore (S. India) 12–3–1945. TYPE deposited in the Herb. Crypt. Ind. Orient; New Delhi, and in Herb. I.M.I., Kew, England.

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SALIX PETIOLARIS J. E. SMITH: AMERICAN, NOT BRITISH

CARLETON R. BALL

At the very end of his review of "Difficulties in North American *Salix*," Dr. M. L. Fernald (8, p. 46–48) discusses *Salix petiolaris* and makes some amazing statements. On page 47, he says: "It seems extraordinary that the identity of our low shrub, *Salix gracilis*, should, for more than a century and a quarter, have been confused by all students of *Salix* with the British tree, *S. petiolaris* J. E. Smith, Trans. Linn. Soc. vi. 122 (1802), Engl. Bot. xvi. t. 1147 (1803), and Fl. Britt. iii. 1048 (1804), etc." On page 48, he concludes: "The latter name [*S. petiolaris*] seems to have been wholly misapplied to our material."

It would have been extraordinary if it had been true. In these statements, however, Fernald offers no definite evidence, but merely a dogmatic conclusion. Therein he tells all American botanists beginning with Pursh (17) in 1814, and all British botanists later than Hooker (12) in 1820, Forbes (10) in 1829, and Loudon (15) in 1838, that they did not know what they were talking about when they denied that *Salix petiolaris* ever was a native British willow. At the outset of this discussion let it be stated emphatically that *S. petiolaris* J. E. Smith was wholly an American plant when published in England in 1802 and still is after 145 years. Now for the evidence, point by point.

Point 1. The Assertion that S. petiolaris is "British." *Salix petiolaris* was described by Sir James Edward Smith (20, p. 122–123) in 1802. His description and notes follow:

> "Salix petiolaris. Dark long-leaved willow.
>
> "S. foliis lanceolatis serratis glabris subtus glaucis, germinibus pedicellatis ovatis sericeis, stigmatibus sessilibus bilobis.
>
> "In salicetis et palustribus. D. Dickson. Fl. Aprili.
>
> "This species has not been found wild in Norfolk, but was sent to Mr. Crowe by Mr. Dickson, along with the last [*S. laurina*], as of British growth. It has most affinity with the two preceding species [*S. laurina* and *S. nigricans*] but has longer and more slender twigs. The leaves are 4 or 5 inches long, about an inch broad, lanceolate, pointed, serrated, somewhat revolute, generally a little unequal at the base; bright green, smooth and shining above; glaucous beneath, and sometimes a little hairy. In drying they turn of a purplish black. The footstalks are peculiarly long, linear, and slender, silky on the upper side. Stipules small, crescent-shaped, toothed, smooth. The female catkins, the only sex I have seen, are scarcely an inch long, with black, hairy, often obovate, often notched, scales. Germens on long footstalks, small, ovate, silky. Stigmas perfectly sessile, ovate, obtuse, divided into two lobes."

Smith described it again, with a colored plate, in 1803. The branches now are included, as "slender, flexible, round, smooth, more or less purplish or

brown" (21, species & plate 1147). As to source, Smith says: "For this new species of *Salix* we are obliged to Mr. Dickson, who found it in some part of Great Britain, the exact place is not remembered, and sent it in a growing state to Mr. Crowe. We know only the female, which is a small spreading tree." It was described again, in Latin (22, p. 1048–49) in 1804.

In his final publication (23, p. 181–182), in 1828, Smith says: "In osier grounds and swamps. Sent from Scotland by the late Mr. Dickson. In Possil marsh, on the north side of the canal, Mr. David Don. Marshes in Angusshire, Mr. George Don. *Hooker.*" He then refers to Pursh's doubt of British origin but does not see why it should not be wild in Europe as well as in North America.

Hooker (12, p. 419), in 1820, refers to the Scottish localities and states: "I have never seen native specimens," which he repeats essentially in later editions. In ed. 6 (p. 386. 1850) he says: "Not uncommon in North America and certainly not a European species, although perhaps as wild in this country as most of our other tree willows." Forbes (10, p. 45) discusses it in 1829. Loudon (15, p. 1533–34), in 1838, reviews previous literature and quotes extensively, but finds no further evidence of British origin.

S. petiolaris has never been included in British floras since these early authors. When revising and monographing the British willows, White (25) in 1890 and Linton (14) in 1913 did not think it necessary to mention it even as an excluded species.

In America, Pursh (17, p. 616), in 1814, follows Smith's description but says: "It has been by mistake adopted as a native of Great Britain." He described also *S. fuscata* Ph. (p. 612) from New York and Pennsylvania, which generally has been considered synonymous with *S. petiolaris* but which, by its obovate-lanceolate leaves, obtuse scales, short-pedicelled capsules, and black-tomentose 1-year twigs, probably is *S. humilis* Marsh., or possibly *S. discolor* var. *latifolia* Andersson.

Hooker (13, p. 148), in 1839, includes *S. petiolaris*, with leaves serrate, from "Lake Winnipeg. Dr. Richardson." Also "*S. rosmarinifolia* L.," with leaves narrow and mostly entire, from "Saskatchewan. Dr. Richardson." This latter is not Linné's species but the later-described *S. gracilis* Andersson. Barratt (7, p. 4), in 1840, says: "This is undoubtedly a native Willow, since both sexes are found here plentifully. The staminate plant was unknown in Great Britain till transmitted by me, in the living state."

Torrey (24, p. 207), in 1843, says: "This species was many years ago adopted by mistake as a native of Scotland, and has ever since obtained a place in British floras, but there can be little doubt that the plant described by Sir J. E. Smith was of North American origin, as Pursh and Lindley have both asserted." All later publications, from Gray's Manual (11, p. 426) in 1848 onward, have recognized *S. petiolaris* as an American species, until Fernald's statement in 1946.

Fernald (8, p. 48) says: "Although Schneider talked all around the subject, . . . , there is no indication in his discussion that he actually compared our species with true *S. petiolaris.*" As "our species" is the true *S. petiolaris,* this criticism falls. But Schneider (19, p. 16–19, not '16–24' as Fernald says) reviews more literature than is discussed herein and quotes the opinions of numerous British and American botanists. He then observes: "How this plant came to England has never been exactly explained."

That *S. petiolaris,* and many other American plants, did reach Great Britain in early days is not surprising. Their tradesmen were on the lookout for material to use in their hand industries, of which basketry was an important member. Their private botanic gardens were constantly obtaining foreign material. Smith himself says (20) that "Mr. Crowe . . . for many years . . . has . . . collected willows, both indigenous and exotic, from all quarters . . ." The occurrence of this American willow as an escape in waste places in Scotland undoubtedly resulted from throwing the twig clippings from basket making into such spots, as has happened in America.

Point 2. Assertion that S. petiolaris is a "tree"; S. gracilis a "low shrub." Fernald says (8, p. 47) "the British tree, *S. petiolaris* J. E. Smith." as contrasted with "our low shrub, *S. gracilis.*" Smith originally did not give the height but in 1803 (21) he says: "We only know the female, which is a small, spreading tree." Forbes (10, p. 45), in 1829, called it "A bushy tree, with slender, spreading . . . branches."

All the British descriptions were drawn from cultivated plants in private botanic gardens. In such gardens, in Britain, the soil was enriched and the plants usually well spaced, with little competition. These conditions stimulate growth to unusually large size. Further, all of the British plants were from cuttings, which insures a single stem and therefore a tree-like habit of growth. As all of the nutrients go to develop a single stem, rather than a clump of stems, this insures increased height. Finally, all of the British plants were female and, being unfertilized, used no nutrient energy in ripening an annual seed crop. No actual heights are given by British authors.

American descriptions, on the other hand, were based on wild plants growing in natural conditions of soil, exposure, and competition. Most of the earlier observations also were made in the extreme southern portion of the range of *S. petiolaris,* where climatic conditions are least favorable to its development. In 1814, Pursh (17, p. 616) follows Smith's description. In 1840, Barratt (7, p. 4) does not record the height. In 1843, Torrey (24, p. 207) says: "stems 4–10 ft. high." In 1865, Wood (26, p. 653) says: "Shrub or small tree 4–15 ft. high," but does not give the source of his information.

Salix petiolaris shows its lowest average height in the southern portion of its range, from New England to Nebraska. Northward, its height steadily increases. In central Saskatchewan and central Alberta, heights of 8, 10,

and 12 feet are recorded commonly. The writer found plants 10–12 feet high (No. 2358) at Clyde, north of Edmonton. Even in extreme northern Alberta (lat. 59° 30′), *Raup 2125* was from a "shrub about 10 ft high." On request, Dr. George H. Turner is measuring heights and studying habit in the Edmonton area. Already, he has found many plants 12–14 feet high, some 15 feet, and one each 17.5, 19.5, and 22 feet in height. His full paper will appear in a Canadian journal.

Several of the writer's plants in the Clyde area were few-stemmed and tree-like in habit, with more or less spreading branches. Dr. Turner already has found several single-stemmed plants in open aspen woods. Some are young and only 4–8 feet high. Others are 11 feet high. All are tree-like in habit, with somewhat spreading branches. He also finds few-stemmed plants 12–14 feet high and tree-like in habit. These taller plants are not "low shrubs," and where they have but one or few stems they are "small trees." Fernald himself says (8, p. 46) that "*S. gracilis* is a slender shrub . . . 1–3 m. high." Now, 3 m. is 10 feet, which is not exactly low for a shrub. The contention for a specific difference in height and habit appears to be unproved.

Fernald further says (8, p. 46): "Typical *Salix gracilis* is smaller and generally more northern" [than his var. *textoris*, which is true *S. petiolaris*]. The 12–22-foot northern plants therefore should be smaller than those farther south. Exactly the reverse is shown to be true.

Point 3. Assertion of Spreading Branches on "British," Erect on American Plant. Fernald states (8, p. 47) that *S. gracilis* of America "is a slender shrub with erect, green to olive-brown tenuous and flexible branches." He further states, quoting Forbes (10, p. 45) with bracketed comments of his own, that the alleged "British" *S. petiolaris* is "a bushy tree, with slender, spreading [not strongly ascending] purplish or dark-brown [not green or olivaceous] branches." The tree-like habit of British-grown plants has been explained above, under Point 2. They were single-stemmed because grown from cuttings, and they were "bushy" because grown widely-spaced in botanic gardens.

With little competition from neighboring plants, or among the few stems of one plant, the branches tend to grow outward. With severe competition from adjacent plants, or among crowded stems of one plant, they necessarily must grow upward. The low, clumpy, many-stemmed plants in northern United States and northward have erect or ascending stems and branches. The fairly common taller plants of more northern Canada, when they have few stems, have more or less spreading branches. Both types of branching, and all degrees of intermediacy, may be seen in some Canadian localities. These differences are environmental and not genetic effects.

Point 4. Statement that S. petiolaris has Purplish; S. gracilis Greenish Twigs. This statement is quoted in Point 3, above. The only answer is that both so-called species have twigs with both ranges of color. Some 275 sheets of *S. petiolaris* in the writer's herbarium, collected from New England westward to Nebraska and Colorado and northward far into Canada, have been examined. Practically all of them show something of the two color ranges but the dominant effect is brown to dark brown rather than green to light brown.

In general, the 3- and 2-year twigs are brown to blackish, especially in summer and autumn. One-year and seasonal twigs often are green to olive-green to yellow, especially early in the season. These differences are noted on the same plant. In general, there is a progressive deepening of the color on all twigs as the season advances. All these facts were especially evident where collections had been made from the same plant at intervals during the season. This has been done by A. J. Breitung, the late A. H. Brinkman, W. C. McCalla, and G. H. Turner in Canada, and F. W. Rapp in Michigan. The average twig color tends to be lighter in the drier Great Plains area than in the more humid eastern areas. Specimens from Nebraska and Colorado, and many from Alberta, show distinctly reddish twigs, which McCalla says are beautifully crimson in spring.

Bebb 24, grown by him from cuttings received from Kew Gardens, England, also shows twigs ranging from greenish to dark brown. Evidently there is no specific difference in twig color between *S. petiolaris* and *S. gracilis*, whatever their relationship.

Point 5. Claim that Only the "British" Plant has Leaves 4–5 Inches Long. The original description of *S. petiolaris* (20, p. 122) says: "The leaves are 4 or 5 inches long and about an inch broad." In 1803, Smith said (21, No. 1147): "Leaves 4 or 5 inches long and almost an inch broad, when full grown." With this second description is plate 1147. It contains, first, a twig with two pistillate aments and leaves 4–6 cm. long and up to 1 cm. wide. It also carries what obviously is a short section of a vigorous autumnal shoot or root sprout, bearing two leaves 4–4.5 inches long and 0.8 inch wide, with long petioles.

Here, then, we have the origin of "leaves 4 or 5 inches long and almost an inch broad." As pointed out by the writer (4, 5), such shoots normally have leaves 1.5 to 2 or even 3 times as large as those on twigs which have borne fruits. Because taxonomic descriptions seldom cover such vigorous shoots, and because their deviation from the taxonomic norm has not been generally known, the meaning of this portion of Smith's description and plate has not been generally recognized.

American plants produce the same large leaves. In the writer's herbarium, a specimen from Quebec has leaves up to 4.8 by 0.6 inches; a New

York specimen up to 4.5–5 by 0.75 inches; two Michigan specimens have leaves up to 4 by 0.75 and 3.5 by 0.85 inches, respectively; and two Iowa specimens bear leaves to 3.5 by 1 and 4 by 1.1 inches, respectively. In late August, 1947, Dr. Turner collected sprouts from plants near Fort Saskatchewan, Alta. Five had blades to 5 inches long, one to 5.5 inches, and one (3 sprouts) had blades to 6 inches in length. Later collections might show longer blades.

But Smith, in 1803, threw further light on his description and plate. He writes (21, No. 1147): "The very young leaves are tinged with an elegant ferrugineous hue, especially in the radical shoots which spring up when a tree is cut down. Such shoots in some species differ greatly from the general appearance of the plant, and require in this genus to be particularly attended to." Here is an early recognition of the plant variation which the writer (4, 5) has been emphasizing. But, more important still, Smith could not have known about leaf hue on "radical shoots" of his *S. petiolaris* unless he actually had seen the growth from a cut tree. The only plants then known to him were those in the Crowe Garden, on which his description was based. This tells us almost certainly that the vigorous shoot in plate 1147, with leaves 4 or 5 inches long, was a root sprout, from which such leaf development would be normal.

Point 6. Claim of Different Scale Color in "British" and American Plants. Smith's original description (20, p. 123) says: "Black, hairy, often obovate, often notched, scales." A year later, he wrote (21, No. 1147): "Scales small, obtuse, often notched, black and hairy." Forbes, who also described only the plants growing in a botanic garden, wrote (10, p. 45): "Scales rounded, notched." Fernald (8, p. 47) says that the scales in American *S. gracilis* are "elongate, entire, and yellowish." What are the facts?

Flower scales, in any willow, are nearly as varying as the leaves, already discussed by the writer (4, 5, 6). As the ament emerges from the bud, the scales in all species are comparatively short and broad, and usually obtuse, no matter what their normal final shape. As the ament develops, the scales change in size, shape, and color. Linton (14, p. 1–2) made observations on such changes. These changes progress faster and farther in the basal portion of the ament than in the apical, in lax aments than in dense ones, and in fertilized aments than in unfertilized. Infertile pistillate aments usually do not become as long or as lax as normal, and their various floral organs do not develop so far. The scales, and the capsules with their pedicels, styles, and stigmas, usually remain shorter and therefore relatively broader than normal.

Male *S. petiolaris* was not known in Breat Britain until sent by Barratt (7, p. 4) and perhaps others some 25 years after the species was described in 1802. The original and later descriptions, therefore, were based on infertile pistillate aments, with consequent error in the knowledge of the actual and

relative size and shape of floral organs. This accounts for some of the differences recorded. In *Bebb 24*, grown in Illinois from English cuttings, the not fully developed scales are broad, and blackish at tip.

A study of numerous American specimens of *S. petiolaris* (and *S. gracilis*) shows that the scales vary from obovate, as the aments open, to oblanceolate at maturity. The apex varies from truncate to slightly erose, or rarely roundish. The color varies from light brown to brown or dark brown, as the scale ages, and is darkest at the tip. If quickly or poorly dried, they are blackish. They blacken more readily when dried while very young and in the "obovate" stage. Specimens were noted in which the young scales, poorly dried, were "obovate and blackish." They never are "yellowish," as described by Fernald, in the sense that those of *S. lucida, S. nigra, S. interior,* and their relatives are yellow or yellowish.

Point 7. Listing of Varieties of S. petiolaris Synonymous with S. gracilis. More problems arise when we consider the relationship of *S. gracilis* Andersson to the American *S. petiolaris* Smith. Fernald, refusing to recognize the latter, described (8, p. 46) his *S. gracilis* var. *textoris* var. nov. as having "capsulis ad 2 mm. longis; foliis maturis glabratis 4–10 cm. longis ad 2 cm. latis evidenter serrato-dentatis." It represents the larger plant here discussed as the true *S. petiolaris*. He then states (8, p. 47) that *S. gracilis* Andersson is "characterized by capsules only 5–7 mm. long and leaves entire or only obscurely denticulate, the mature ones only 2.5–7 cm. long and 3–11 mm. broad." It is not the purpose here to decide whether a variety of *S. petiolaris* with allegedly lower stature, smaller subentire leaves, and smaller capsules shall be recognized. The present object is to point out the errors made by Andersson, Schneider, and Fernald in discussing and creating certain names and combinations.

Andersson, in his compilation of the willows of North America (1), described *S. petiolaris* Smith on page 126 and compared it only with *S. sericea* Marsh., which he erroneously called "*S. grisea* Marsh." On page 127, five species later, he described his new species, *S. gracilis,* citing the "*S. rosmarinifolia* L." of Hooker (13, p. 148) as a synonym. He expresses much doubt as to the actual relationships of his *S. gracilis* but did not compare it with *S. petiolaris,* in spite of calling Hooker's plant a synonym. *S. gracilis* has been regarded by most later authors either as a synonym of *S. petiolaris* or as a variety of it, with smaller, narrower, mostly entire leaves.

To his new species, *S. gracilis,* Andersson attached a new variety, *rosmarinoides* Andersson. The only significant character assigned to it, in the very brief and jumbled Latin description, is "foliis apicem versus serrulatis," whereas of his *S. gracilis* he says "foliis . . . integerrimis." In other words, his var. *rosmarinoides* was the true *S. petiolaris,* which he does not even mention in discussing the relationships of his *S. gracilis*. Andersson seems

to have realized his error presently, for var. *rosmarinoides* is never mentioned again, in his two monographs (2, 3) of 1867 and 1868. In 1867, moreover, he reduced his *S. gracilis* to a subspecies of *S. petiolaris*. In 1868, he reduced it (3, p. 235) to a variety of *S. petiolaris*, thus ending his doubts as to their relationships. All of this would be unimportant but for the later erroneous actions of both Schneider and Fernald.

Schneider, in 1920, published (19, p. 19) his "*S. petiolaris* var. *rosmarinoides* comb. nov.," which he said was based on "*S. petiolaris* * *rosmarinoides* Andersson" of 1858. Here Schneider makes a first error. Andersson made no such combination in 1858, nor in any other year. As noted above, his combination in 1858 was "*S. gracilis* * *rosmarinoides*," a variety which he immediately abandoned and never mentioned again. Schneider's second error was in assuming that the asterisk in Andersson's combination denoted a subspecies instead of a variety. It did not, as placed in that publication, and Gray correctly called it "var. *rosmarinoides*" in the simultaneous American edition (1, Am. ed. p. 67). Andersson's publications are full of the inconsistent use of numerals, Greek letters, and asterisks to denote varieties. If Andersson's variety really had been one of *S. petiolaris*, therefore, Schneider's combination would not have been "new," but a repetition. As Andersson made no such combination, Schneider's combination has no base.

Schneider cites *S. gracilis* Anders. of 1858, *S. petiolaris* subsp. *gracilis* Andersson of 1867, and *S. petiolaris* var. *gracilis* Anders. of 1868 as synonyms of his (Schneider's) "var. *rosmarinoides*." Obviously they are not, because they represent the *gracilis* concept, whereas his "var. *rosmarinoides*" represents the *petiolaris* concept, as Andersson himself had recognized after 1858. In other words, Schneider was making *S. petiolaris* (*S. gracilis* var. *rosmarinoides* Anders.) a variety of itself.

Fernald (8, p. 46–47), in 1946, says of *S. gracilis*: "It is *S. petiolaris* vars. *rosmarinoides* (Anders.) Schneider and *angustifolia* Anders. . . ." Here he follows Schneider in the errors just discussed. But Fernald, refusing to recognize *S. petiolaris* as an American plant, had just described (8, p. 46) his "*S. gracilis* Anders. var. *textoris* var. nov." Actually, his variety *textoris* represents the American form with larger serrate leaves, which is the true *S. petiolaris* Smith. But because Andersson (1, p. 126–127), after describing *S. petiolaris*, redescribed the same form as *S. gracilis* var. *rosmarinoides* Andersson [var. nov.], Fernald's *S. gracilis* Anders. var. *textoris* var. nov. also is a synonym of Andersson's *S. gracilis* var. *rosmarinoides*.

Fernald was in error also in omitting *S. petiolaris* var. *gracilis* Andersson of 1868 from his above-named list of varieties of *S. petiolaris* which are synonyms of *S. gracilis*. Here he probably was misled by Schneider's erroneous reference.

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BULLETIN OF THE TORREY BOTANICAL CLUB
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EUPHORBIA MACULATA: A REJOINDER[1]

LEON CROIZAT

In his comments (Bull. Torrey Club **74**: 332. 1947) upon my notes (Bull. Torrey Club **74**: 153. 1947) concerning the proper application of *Euphorbia maculata* L., Fosberg charges me with being guilty of what he calls a curious oversight, because I failed to pay attention to a putative "typification" of *E. maculata* effected by Linnaeus in the *Mantissa*.

The readers of the discussion between Fosberg and myself would be poorly served, I believe, if this charge were allowed to stand. It is a fact that I have not discussed the "typification" of the *Mantissa*, and even less deemed it relevant, for the reason that I hold to the opinion that in the *Mantissa* no typification was ever made, as Fosberg believes. In the *Mantissa*, Linnaeus merely added one more reference to the garbled synonymy of the *Species Plantarum*.

I am not alone in this opinion, for this opinion is shared by Boissier, a taxonomist of unusual discrimination and ability, and the uncounted thousands of taxonomists who, implicitly or explicitly, have constantly accepted *E. maculata* in the sense I myself hold.

Finally, I should like to point out that stability of nomenclature is one of the keystones of the *Rules*. Botanists who believe that Fosberg has a case, after all, are bound to notice that only *absolute proof* that the previous sense of *E. maculata* is illegitimate may justify their rejecting this sense in order to follow the proposed new usage. No such proof has been created by the assertion that I have supposedly overlooked a text which I, and many other botanists, deem irrelevant.

MINISTERIO DE AGRICULTURA Y CRÍA, DEPARTAMENTO DE
INVESTIGACIONES FORESTALES
CARACAS, D. F., VENEZUELA

[1] The editor believes that no good purpose will be served by prolonging this controversy in these pages, unless new facts are discovered. The present paper is published only in deference to Dr. Croizat's fear that a misinterpretation of his position might result if the matter were allowed to rest with Dr. Fosberg's reply.

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PLANT EXPLORATIONS IN GUIANA IN 1944, CHIEFLY TO THE TAFELBERG AND THE KAIETEUR PLATEAU—II

BASSETT MAGUIRE AND COLLABORATORS

CYCLANTHACEAE

CYCLANTHUS BIPARTITUS Poit. BRITISH GUIANA locally frequent, low ground, mixed mora forest, banks Kamuni Creek, Groete Creek, Essequibo River, *22938*. Widely distributed from the Antilles, through the Amazon Basin to Peru. Known from several stations in British Guiana. Apparently unrecorded from Surinam.

CARLUDOVICA CORONATA Gleason. BRITISH GUIANA: climber, in dense thickets, second growth in windfall opening, mora forest, Kamuni Creek, Groete Creek, Essequibo River, *22867a;* hemi-epiphyte, Baramanni Creek, Waini River, N. W. D., *F2342*. Apparently known definitely only from British Guiana, where it is widely distributed. Sandwith[22] records two specimens from Tobago that may be referable to *C. coronata*.

Carludovica Fanshawei Maguire, sp. nov. Herbae scandentes; laminis ad $\frac{2}{3}$ vel basis bipartitis, segmentis late oblanceolatis, abrupte brevi-acuminatis, 5-nerviis; spathis ut videtur 2; staminibus numerosis, receptaculis concavis; segmentis perianthiis floribus femineis basis connatis, lobis late triangularibus, stigmatibus sessilibus; seminibus ignotis.

Climbing epiphyte; stems fleshy, 1–2 cm. thick; petioles 12–18 cm. long, the broadly clasping sheaths 4–5 cm. long, the blades bipartite for $\frac{2}{3}$ their length, 15–20 (22) cm. long, the segments 10–15 cm. long, 5–7 cm. broad, oblanceolate, abruptly short-acuminate, 5-nerved on each surface; peduncle ca. 10 cm. long, subtended by several imbricated bracts 5–8 cm. long; spathes apparently 2, from the upper portion of the peduncle, caducous; spadix 5 cm. long, 2 cm. broad; stamens numerous, covering entire surface of the concave receptacle, anthers 0.5 mm. long, filaments 0.6–0.8 mm. long, pedicels flattened or sharply 3-angled, ca. 1.2–1.5 mm. long; perianth members of the pistillate flower connate at the base, the lobes broadly triangular, 1.5–2.0 mm. high, bearing a thickened structure internally near the apex; stigmas essentially sessile, ovate-oblong, more or less remote, receptive surface thick, linear.

TYPE: hemi-epiphyte with fleshy stem 1–2 cm. thick, clinging by adventitious roots but rooted in ground, to 15 feet high, leaves bifurcate, spadix green, spathe fallen, on trees in marsh forest, 12 miles up Kaituma River, British Guiana, March 14, 1945, *Fanshawe 514*. New York Botanical Garden. Known only by the type collection.

Carludovica fimbriata Maguire, sp. nov. Herbae terrestres; laminis foliorum ad $\frac{2}{3}$ vel basin versus bipartitis, segmentis lanceolatis, acuminatis, apicibus obtusis, vaginis terminatis ad extremum manifeste fimbriatis; spathis ut videtur 2; discis florum stamineorum planis, lobis 5, perianthiis lobis orbiculatis, staminibus 5–7, filamentis filiformibus, brevibus, anthera-

[22] Kew Bull. 1938: 380.

rum lobis divergentibus, perianthii lobis florum femineorum 4, stigmatibus sessilibus, planis, cruciformis; seminibus ignotis.

Terrestrial herb; caudex erect, fleshy, about 5 cm. or less long, leaves 2–4 surmounting a short crown, the petioles 10–30 cm. long, 2–3 mm. broad, rigid, adaxial side shallowly canaled, blades some 15–35 cm. long, bipartite for more than ⅔ their length, the segments 3–6 cm. wide, entire, lanceolate, principal veins 14–16, alternately raised and impressed, the reverse condition obtaining on the opposite surface, the apex slender, acuminate, finally blunt, the sheaths 4–7 cm. long, broadly enfolding the stems, truncately terminating in an arcuate vascular plexus beyond which extend the 2–4 cm. long auricular ligules in which the mesophyl tissues quickly disintegrate, leaving a conspicuous fringe of vascular fibers; peduncles 1–3, 10–15 (17) cm. long, slender, rigid; spathes apparently 2, affixed near the apex of the peduncle, the inner about 3 cm. long, lanceolate; spadices 10–13 mm. long, about 10 cm. thick; pedicels of staminate flowers ca. 0.5 mm. long, equally broad and much flattened, disc plane, the 5 lobes narrowly and acutely lanceolate, ca. 0.5–1.0 mm. long, perianth lobes rounded, ca. 0.3 mm. long, whitish-margined, stamens 5–7, filaments delicate, ca. 0.3 mm. long, anther lobes 0.6–0.7 mm. long, divergent; perianth members of the pistillate flowers 4, erect, broadly triangular-ovate, chartaceous and involute, at length becoming pustulate, stigma 3–3.5 mm. across, sessile, plane, cruciform, the lobes oblong-orbicular, pustulate, the margins stramineous, the darker stigmatic surface linear; seed unknown.

TYPE: frequent, among rocks along small stream, mixed montane forest, Km. 15, Coppenam River Watershed, Surinam, July 23, 1944, *Maguire 24159*. New York Botanical Garden.

Carludovica fimbriata is to be associated with *C. pygmaea* Gleason, *C. nana* Gleason, and *C. angustissima* Sandwith, from British Guiana, and *C. insularis* Gleason from Tobago, British West Indies, all belonging to Section I as arranged by Gleason[23] in his review of Demerara *Carludovica*.

The name *fimbriata* is suggested for our new species because of the conspicuous fringed remnant of the leaf-sheath auricles, a character that seems to obtain throughout the section.

CARLUDOVICA GLANDULOSA Gleason. BRITISH GUIANA: frequent, in damp soil of mixed mora forest, Kamuni Creek, Groete Creek, Essequibo River, *22830*. Known previously only from the type, *Jenman 2105*, Mt. Russell District, British Guiana.

CARLUDOVICA LATIFRONS Drude. BRITISH GUIANA: hemi-epiphyte with fleshy stems 2–4 cm. thick, 12 miles up Kaituma River, *F 2405;* terrestrial, stems 30 cm. tall, dicymbe forest, Kaieteur Gorge, 1 mile below Falls, *23533*. SURINAM: frequent, mixed high forest, rocky south slopes of Arrowhead Basin, Tafelberg, *24604* (sterile). The preceding three collections are only tentatively referred to this species, none being positively identifiable. British Guiana through the Amazon Basin to Peru.

CARLUDOVICA SARMENTOSA Sagot ex Drude. BRITISH GUIANA: climber from crown of mora tree, Waíapi Creek, Lower Mazaruni River, *F1415*. British Guiana, the Amazon Basin, south to the Province of Bahia and Rio de Janeiro.

CARLUDOVICA STYLARIS Gleason, Bull. Torrey Club **56**: 7. 1929. With the abundance of new material now available, it is desirable to offer the fol-

[23] Bull. Torrey Club **56**: 2. 1929.

lowing emended description. From the additional characters here recognized it seems evident that *C. stylaris* and probably also *C. glandulosa* belong to Sect. *Sarcinanthus* (Oersted) Gleason.

Terrestrial herb; stems usually 5 cm. or less long; petioles slender, 4–10 dm. long, the clasping sheath 1–2 dm. long, without free auricles; blades 3–8 dm. long, bipartite for less than ¼ their length, the segments 5–9 cm. broad, with 4 or 5 principal nerves, abruptly acuminate; peduncle 1.5–3.0 dm. long, invested with several basal sheathing narrow bracts, as much as 10 cm. long; spathes 3, affixed above the middle of the peduncle, the lowermost lanceolate, 8–10 cm. long, acuminate, the upper two broader and somewhat less long; spadices 3–6 cm. long, 2–4 cm. thick; staminate flower asymmetrical, the pedicels thick, ca. 0.5 mm. long, perianth lobes 5–7, rounded, fleshy, ca. 0.3 mm. long, each bearing a conspicuous external basal gland; stamens numerous, ca. 30, completely covering the plane or slightly concave receptacle, anthers ca. 0.7 mm. long, oblong-quadrangular, the connective extending beyond the anther sacs as a blunt projection, the filaments less than 0.2 mm. long, thick, expanded into conspicuous swollen subglobose bases; perianth lobes of the pistillate flower broadly triangular, fleshy, bearing a thick umbo within; styles pyramidal, stout, ca. 1 mm. long at maturity, probably longer at anthesis, stigmas connate, globose-oblong, the stigmatic surface linear; ovary completely sunken into the axis of the spadix, unilocular, the columella and ovules suspended from the summit; seed fusiform, ca. 2.5 mm. long, 0.75 mm. broad, funiculus 1 mm. long, apical appendage awl-shaped, 1.5–2.0 mm. long.

BRITISH GUIANA: occasional, leaves bipartite, leathery, spadix white, cylindrical, from forest streamside, Kaieteur Plateau, vicinity Kaieteur Falls, British Guiana, *23407*. SURINAM: frequent, low damp ground under high bush, 0.5 km. north of Savanna II, Tafelberg, Surinam, 560 meters altitude, *24407*; common, low bush east of North Ridge, near escarpment, Tafelberg, Surinam, 545 meters altitude, *24288*. British Guiana and Surinam.

MAYACACEAE

MAYACA LONGIPES Mart. ex Seubert. BRITISH GUIANA: locally frequent aquatic, sterile, shallow embayment, Potaro River landing, a mile above Kaieteur Falls, *23406*. SURINAM: lodged in branches of shrubs overhanging Saramacca River, vicinity Pakka Pakka, *23961* (sterile). No *in situ* material seen. British Guiana south to the Amazon River drainage.

XYRIDACEAE

Abolboda acaulis Maguire, sp. nov. Plantae perennes; caudicibus brevissimis; foliis numerosis lineari-lanceolatis, 7–9-nerviis, valde abrupteque aristatis; spicis sessilibus; sepalis 2 vel 3, naviculiformibus, apiculatis; corollis caeruleis, hypocrateriformibus; staminibus 3, staminodiis 3, filiformibus; ovariis oblongo-ovatis, puberulentibus, 3-locularibus; stigmatibus crateriformibus, fimbriatis, appendicibus 3; capsulis papillosis; seminibus globosis, costatis.

Plants perennial, acaulous; caudex short, simple or cespitose, fleshy, 1–2 cm. high; leaves numerous, densely imbricate, 8–18 mm. long, 1.5–2.5 mm. broad, linear-lanceolate, glabrous, subcoriaceous, prominently 7–9-nerved, the base dilated, the apex abruptly terminating in a stiff awn 1–1.5 mm.

long; spike sessile, surpassed by the upper leaves, several-flowered; bracts 4–6 mm. long, similar to the leaves but less firm, scarious, the nerves inconspicuous, the awn 0.5 mm. or less long; sepals 2 or occasionally 3, boat-shaped, 6–7 mm. long, acute, apiculate, scarious; corolla blue, hypocrateriform, ca. 15 mm. long, the lobes broadly elliptic, 5–7 mm. long; stamens 3, inserted below the base of the lobes, anthers ca. 1 mm. long, filaments ca. 1 mm. long; staminodia 3, filamentous, nearly as long as the style, enlarged somewhat distally, acute; ovary oblong-ovate, minutely pubescent at summit, ca. 2 mm. long, 3-locular, placenta central, ovules numerous; style 8–10 mm. long, stigma crateriform, fringed, ca. 1 mm. long, style-appendages 3, basal 0.5–0.8 mm. long, broadly clavate, sometimes the third much elongate and less clavate, or only 1 appendage present, or all obsolete; capsule 3–3.5 mm. long, chartaceous, apex obtuse or truncate, papillose; seed 0.5–0.7 mm. long, globose, 14–15 longitudinally ribbed, dark red-brown.

TYPE: flowers blue, locally common, shallow sand pockets in conglomerate bed rock, vicinity rest house, Kaieteur Plateau, British Guiana, April 30, 1944, *Maguire & Fanshawe 23096*. New York Botanical Garden.

Abolboda acaulis, but for its acaulescent habit, superficially resembles *A. americana*, with which it is usually associated in the field. As in *A. grandis*, staminodia are well developed in *A. acaulis*, a character apparently not before observed in the genus. The presence of staminodia in at least these two species, the unbranched stigma, and the frequent total absence of style appendages in *A. acaulis* diminish somewhat the hitherto assumed[24] very sharp distinction between *Abolboda* and *Xyris*.

ABOLBODA AMERICANA (Aubl.) Lanj. The collections here reported further our understanding of variation in *A. americana* and make desirable an extension of Lanjouw's[25] recently emended description. Our additional material shows: the leaves to reach 12 cm. in length, 1.5 mm. in width, the apex minutely apiculate or completely rounded; the scapes 15 cm. in length; the floral bracts 7 mm. in length, with boat-shaped and prolonged thickened blunt or apiculate appendages, 0.5–2.0 mm. long; capsule 3.5–4.5 mm. in length, firm, valves obtusely triangular at the apex; seed 0.5–0.7 mm. long, broadly oblong, light gray-brown.

Lanjouw (op. cit.) has altogether satisfactorily established the proper name *A. americana* for this species, and has properly brought the name *A. Poeppigii* Kunth into synonymy under it.

The question is now raised as to whether *A. imberbis* is not also conspecific with *A. americana*. The two were distinguished by Malme[26] in the following manner (and by Suessenguth and Beyerle[27] in essentially the identical phraseology, but in German):

A. Folia 3–4 cm longa, circiter 1 mm lata, 5–7-nervia. Bracteae spicae apiculo subfiliformi, usque 8 mm longo munitae.
A. imberbis Humb. & Kunth (1825). (Guyana.)

B. Folia 3–4 cm longa, circiter 0.5 mm lata, trinervia. Bracteae spicae apiculo brevi, circiter 1 mm longo munitae.
A. Poeppigii Kunth (1843) (priori valde affinis, forte non diversa). (Pará.)

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[24] **Suessenguth, K. & Beyerle, R.** Über die Xyridaceengattung *Abolboda*, Humb. & Bonpl. Bot. Jahrb. **67**: 132–142. 1935.

[25] Rec. Trav. Bot. Néerl. **34**: 493. 1937.

[26] Ark. Bot. **19**[13]: 1–8. 1925.

[27] Bot. Jahrb. **67**: 139. 1935.

Leaf length and width are variable, indeed material from the Kaieteur Plateau, and certainly representing a single species, alone has leaves from 2–12 cm. long and from 0.5–1.5 mm. wide, thus breaking down the leaf-width difference as given in the above key. But another leaf character seems to be of significance. In plants from the coastal savannas of Surinam and from the Kaieteur Plateau, the leaves are somewhat fleshy, thickish, and more of less rigidly erect or ascending. But in collections from Tafelberg in Surinam and Esmeralda in Venezuela, the leaves are thin and lax. Coincident with this leaf difference, the plants from the latter two areas have 1–3-flowered spikes, thick bracts 5–6 mm. long with slender, short, awn-tipped appendages, while the spikes of plants from coastal Surinam and Kaieteur are usually 3–5-flowered and have broader bracts usually 6–7 mm. long with thicker, blunt, or merely apiculate appendages.

There is little question but that both forms are of the same species, although they probably represent good varieties. Furthermore, it is probable that the smaller variant represents specimens that must come under *A. imberbis* H.B.K., since in the original description[28] the leaves were characterized as "linearia, graminea, ..." the bracts as "Glumae, ... uniflorae, lanceolatae, acuminatae." Should the bracts have been provided with an appendage "8 mm." long, longer than the body of the glume itself, Humboldt, Bongland, and Kunth would hardly have written merely "lanceolatae, acuminatae." It must be assumed, then, that the Atabapo plants are similar to those from Esmeralda, some 100 or more miles to the eastward, now before me, and that the ascription by Malme of "bracteae spicae apiculo subfiliformi, usque 8 mm longo munitae" must have resulted in some error in phraseology.

Accordingly, the two varieties of the species are delimited as follows:

ABOLBODA AMERICANA var. **americana** Maguire, var. nov. *Xyris americana* Aubl. Hist. Pl. Gen. Franç. 1: 40, t. 14. 1775, as to type; *Abolboda Poeppigii* Kunth, Enum. Pl. **4**: 27. 1843. Leaves usually 3–12 cm. long, 0.5–1.5 mm. wide, fleshy, obtuse or apiculate, 3-nerved; scapes usually 5–15 cm. long; spikes 3–5-flowered; bracts 5–7 mm. long, the appendage obtuse, sometimes apiculate; seed 0.6–0.7 mm. long.

TYPE: "Cayenne. *Mr. Fusee, Aublet.* 1775." BRITISH GUIANA: common tufted perennial in damp sand or shallow water, overlying bed rock conglomerate, Kaieteur Plateau, *23116; 23178; 23188.* SURINAM: inundated open savanna, Zanderij I, *Stahel 115;* grass savanna, Zanderij II, *23666.* Open wet sandy habitats, Pará to Surinam and British Guiana.

A. AMERICANA var. **imberbis** (H.B.K.) Maguire, comb. nov. *A. imberbis* H.B.K. Nov. Gen. Sp. **1**: 256. 1815. Leaves usually 2–3 (4) cm. long, 0.5–0.75 mm. wide, apiculate, thin, lax, strongly 3-nerved; spikes 1–3-flowered; bracts 5–6 mm. long, the appendage slender, short-awned; seed 0.5–0.6 mm. long.

TYPE: "Crescit in arenosis Guayanae ad flumen Atabapo." International boundary between Colombia and Venezuela. VENEZUELA: in running stream in woods, Grand Savanna, Section I, Esmeralda, November 1, 1929, *Tate 229.* SURINAM: frequent, Savanna I, Tafelberg, *24211.* Savannas of southern Venezuela, Tafelberg in Surinam.

Abolboda psammophila Maguire, sp. nov. Plantae perennes; caudicibus brevissimis; foliis numerosis, dense imbricatis, sine nerviis vel obscure

[28] H.B.K. Nov. Gen. Sp. 1: 256. 1815.

3–5-nerviis, abrupte apiculatis; sepalis 2, lanceolato-acuminatis; floribus ignotis; capsulis oblongis, glabris; seminibus globosis, costatis.

Plants perennial, simple or cespitose, caudex short, fleshy, acaulous, 1–2 cm. high; leaves numerous, densely imbricate, 5–12 mm. long, 1.0–1.5 mm. broad, lanceolate, becoming terete toward the obtuse, abruptly apiculate apex, nerveless or indistinctly 3–5-nerved, strictly ascending or somewhat outcurved or incurved; the bracts a little broader, acute, terminating in a distinct awn; sepals 2, lanceolate-acuminate, 5.0–5.5 mm. long, subscarious; flowers not seen; capsule 2.5–2.8 mm. long, oblong, subscarious, chartaceous at the acute, totally glabrous apex; seed 0.5–0.6 mm. long, globose, obovate, grayish red-brown, 12–16 longitudinally ribbed.

TYPE: frequent acaulescent perennial, open sandy areas subject to frequent inundation, west side of railway, Zanderij II, Surinam, June 3, 1944, *Maguire & Stahel 23667*. New York Botanical Garden.

Similar to *A. acaulis* from the Kaieteur Plateau, British Guiana, but the leaves nerveless or essentially so, blunt, and ascending, and the capsules acute and glabrous, whereas in the Kaieteur species the leaves are broader, strongly nerved and awned, and the capsule firmer, obtuse, and papillose.

ABOLBODA GRANDIS Griseb. BRITISH GUIANA: perennial cespitose herb with thick fleshy rootstock, stems to 1 m. high, ephemeral blue flowers, frequent in damp sand, Kaieteur Plateau, *23148*. Venezuela, the Guianas, Pará, and Amazonas.

ABOLBODA GRANDIS var. MINOR Spruce apud. Malm. SURINAM: frequent, stony bank Geijskes Creek, Black Water Camp (5), Coppenam River Headwaters, *24176;* Savanna I, Tafelberg, *24215*. A weak variant recorded previously from Altos, Amazonas, but probably throughout the range of the species.

ERIOCAULACEAE[29]

Eriocaulon heterodoxum Moldenke, sp. nov. Herba parva acaulescens; foliis graminoideis 2–8.5 cm. longis, 3–4 mm. latis, rectis acutis vel subacutis utrinque glabris multinervatis plusminus fenestratis; vaginis 2–3 cm. longis, glabris, laminis erectis arcte acutis vel subacuminatis, adpressis; pedunculis 3–12, brunnescentibus, 5–12 cm. longis, glabris; receptaculo glabro; bracteis involucrantibus brunneis elliptico-lanceolatis vel ellipticis obtusis glabris nitidis; bracteis receptaculi late obovatis glabris; floribus ♂ dimeris; floribus ♀ trimeris.

Small acaulescent herb; leaves grass-like, 2–8.5 cm. long, uniformly dark green on both surfaces, erect, 3–4 mm. wide, acute or subacute at apex, glabrous on both surfaces, many-nerved, the younger ones and the basal portions of the older ones more or less fenestrate, the venation indiscernible on the apical portion of older leaves; sheaths rather loose, 2–3 cm. long, shorter than the leaves, glabrous, obliquely split at the apex, the blade erect, sharply acute or subacuminate, appressed, not at all divergent; peduncles comparatively stout, 3–12 per plant, 5–12 cm. long, erect, brunnescent, several-costate, twisted, glabrous; heads brown, obconic-hemispheric, 3–6 mm. wide; involucral bractlets brownish, elliptic-oblanceolate or elliptic, about 2.6 mm. long and 1.3 mm. wide, obtuse at apex, glabrous, shiny; receptacle glabrous; receptacular bractlets broadly obovate, about 1.5 mm. long and 0.9 mm. wide, brownish toward the apex, abruptly subacute at the apex,

[29] By Harold N. Moldenke.

long-cuneate to the base, convex on the back, glabrous, not bearded; staminate florets few: sepals 2, connate only at the very base, oblanceolate, somewhat falcate, convex on the back, brownish except at the very base, about 1 mm. long and 0.3 mm. wide, subacute and irregularly erose-laciniate at the apex, glabrous, not bearded; petals 2, subhyaline, united into a very slender tube about 1.3 mm. long, glabrous, free above, the lobes 2, about 0.34 mm. long, subacute, glabrous, bearing a small black gland at the apex, not bearded; stamens 4, 2 opposite and 2 alternate with the petals; rudimentary style black, 2-lobed; pistillate florets very numerous: sepals 3, separate, narrow-elliptic, about 1.3 mm. long and 0.2 mm. wide, hyaline or very lightly stramineous, acute at apex, glabrous, eglandular, not bearded; petals 3, narrow-elliptic, hyaline, separate, 1–1.3 mm. long, about 0.2 mm. wide, acute at apex, glabrous, bearing a small black gland at the apex; pistil single; style 0.4–0.5 mm. long, glabrous; stigmas 3, about 1 mm. long or longer, divergent; ovary subglobose, about 0.4 mm. long and wide, angular, glabrous, 3-celled, 3-ovulate.

TYPE: sandy forest shore below high tide limit on the river tidal flats, Mazaruni Forest Station, British Guiana, May 23, 1944, *Maguire & Fanshawe 23570*. New York Botanical Garden. The collectors describe the species as "local." It is a most remarkable species because of having trimerous pistillate and dimerous staminate florets in the same head!

PAEPALANTHUS BIFIDUS (Schrad.) Kunth. BRITISH GUIANA: 50 miles north of Bartica, *22974;* in white sand, Bartica Road, *23561;* low annual from open spaces on white sand, Sandhills, Demerara River, *F905*. Colombia and the Guianas to Minas Geraes, Brazil.

Paepalanthus brunneus Moldenke, sp. nov. Herba caulescens; caulis 2–10 cm. longis, dense foliatis; foliis graminoideis, 1–2 cm. longis, 1–4 mm. latis, argute acutis vel submucronulatis brunnescentibus utrinque glabris multinervatis; vaginis gracilibus arcte adpressis 1–1.8 cm. longis, brunnescentibus, glabris vel ad apicem parcissime pilosis, laminis erectis argute acutis vel submucronulatis; pedunculis gracilibus, 2–7 complanatis, 5–12 cm. longis, glabris; bracteis involucrantibus ellipticis brunneis acuminatis ad marginem et versus apicem villosis; receptaculo dense villoso; bracteis receptaculi oblanceolatis brunneis barbatis; floribus trimeris.

Caulescent herb; stems very slender, 2–10 cm. long, simple, erect or ascending, often quite abbreviated, densely leafy; leaves grass-like, 1–2 cm. long, 1–4 mm. wide at the base, sharply acute or submucronulate at the apex, rather uniformly dark green on both surfaces, brunnescent in drying, glabrous on both surfaces, 7–15-nerved with close parallel veins, sometimes faintly fenestrate; sheaths slender, closely appressed to the peduncle, 1–1.8 cm. long, brunnescent, equaling the leaves, glabrous throughout or with a very few scattered dark colored hairs near the apex, obliquely split at the apex, the blade firm, erect, sharply acute or submucronulate at the apex; peduncles slender, brunnescent, 2–7 per plant, 5–12 cm. long, several-costate, flattened in drying, erect, glabrate throughout; heads dark brown, hemispheric, about 2 mm. high and 2–4 mm. wide; involucral bractlets elliptic, 1.8–2 mm. long, about 0.7 mm. wide, brown, acuminate at the apex, villous at the margins at and near the apex, otherwise glabrous and shiny; receptacle very densely long-villous; receptacular bractlets oblanceolate, about 1.5 mm. long and 0.5 mm. wide, brown, bearded at the apex with brown divergent blunt hairs; staminate florets stipitate: sepals 3, connate only at

the very base, oblanceolate, brown, about 1 mm. long and 0.3 mm. wide, erect, firm, rounded at the apex and there densely bearded with short erect stramineous hairs; petals 3, connate into a hyaline infundibular tube, involute at apex, eglandular; stamens 3, slightly exserted from the corolla-tube; anthers 4-celled; pistillate florets: sepals 3, connate only at the very base, oblanceolate, brown, erect, firm, about 1 mm. long and 0.3 mm. wide, bearded on the back at the apex with short erect stramineous hairs; petals 3, separate, similar to the sepals or slightly smaller and narrower, villous on the back; pistil about 1.3 mm. long, glabrous; stigmas 3; ovary 3-celled.

TYPE: locally common, chiefly on white sand, secondary scrub forest, Amatuk Portage, Potaro River Gorge, British Guiana, April 27, 1944, *Maguire & Fanshawe 23020*. New York Botanical Garden. Described by the collectors as "erect annual, to 20 cm. high." The species resembles in general habit *Eriocaulon caesium* Griseb. of Trinidad.

PAEPALANTHUS CAPILLACEUS var. PROLIFERUS Gleason. BRITISH GUIANA: aquatic in swiftly flowing stream, Kaieteur Plateau, *23243*. The variety is known only from British Guiana and Amazonas, Venezuela.

PAEPALANTHUS FASCICULATUS (Rottb.) Körn. BRITISH GUIANA: in white sand of clearing, Kangaruma, *23001;* in white sand, Bartica Road, *23560*. SURINAM: common in sand along railroad near Km. 70, *23618;* frequent in sandy soil of open places, islands of Brokoboto Rapids, 3 hours above Pakka Pakka, Saramacca River, *23983*. Colombia and Venezuela through the Guianas to northern Brazil.

PAEPALANTHUS FASCICULATUS f. TENELLUS Herzog. SURINAM: in sand at base of escarpment, Tafelberg, *24677;* frequent at base of dripping cliffs, north escarpment, Tafelberg, *24191;* frequent, moist rocks at base of north escarpment, Tafelberg, *24298*. The form is known only from Surinam and Amazonas, Venezuela.

Paepalanthus filipes Moldenke, sp. nov. Herba parva acaulescens; foliis rosulatis brunnescentibus linearibus 1–1.5 cm. longis, ca. 1 mm. latis, erectis vel plerumque reflexis utrinque glabris; vaginis arcte adpressis ca. 1.5 cm. longis brunnescentibus glabris, laminis brevibus erectis obtusis; pedunculis filiformibus stramineis vel brunneis 4.5–9 cm. longis tricostatis glabratis; bracteis involucrantibus stramineis elliptico-oblanceolatis vel ellipticis abrupte acutis glabris; receptaculo longe villoso; bracteis receptaculi parvis paucis hyalinis oblanceolatis acutis glabris; floribus trimeris.

Small acaulescent herb; leaves rosulate, uniformly dark green on both surfaces, brunnescent in drying, linear, 1–1.5 cm. long, about 1 mm. wide, erect or more usually somewhat reflexed, glabrous on both surfaces, rather blunt at the apex, the venation indiscernible; sheaths narrow-cylindric, closely appressed to the peduncle, surpassing the leaves, about 1.5 cm. long, brunnescent, glabrous, obliquely split at the apex, the blade short, erect, blunt; peduncles filiform, stramineous or brunneous, 4.5–9 cm. long, 3-costate, twisted, glabrate or with a few scattered hairs toward the base and apex; heads stramineous, obconic or hemispheric, 1.5–4 mm. wide; involucral bractlets stramineous, elliptic-oblanceolate or elliptic, about 1.5 mm. long and 0.5 mm. wide, abruptly acute at the apex, glabrous, not bearded; receptacle long-villous; receptacular bractlets small, few, hyaline, oblanceolate, about 0.6 mm. long and 0.1 mm. wide, acute at the apex, glabrous; staminate florets: sepals 3, connate only at the very base, hyaline, oblanceolate, about 1.3 mm. long and 0.5 mm. wide, subacute at the apex, convex on the back,

long-villous at the very base, otherwise glabrous, not bearded; petals 3, united to form a very slender, stramineous, infundibular tube about 1 mm. long, glabrous, separate and involute at the apex, the lobes hyaline; stamens 3, slightly exserted; pistillate florets: sepals hyaline, oblanceolate, separate or connate only at the very base, about 1.5 mm. long and 0.5 mm. wide, acute at the apex, sparsely villous along the margins, convex on the back, not bearded; petals 3, narrowly elliptic-oblanceolate, hyaline, about 1.5 mm. long and 0.2 mm. wide, obtuse or subacute at the apex, long-villous on the back, not bearded, eglandular; pistil about 1.3 mm. long, glabrous; ovary 3-celled, 3-ovulate; stigmas 3.

TYPE: locally common, chiefly on white sand, secondary scrub forest, Amatuk Portage, Potaro River Gorge, British Guiana, April 27, 1944, *Maguire & Fanshawe 23021*. New York Botanical Garden. The collectors describe it as an "erect annual to 12 cm. high; flower heads whitish."

Paepalanthus griseus Moldenke, sp. nov. Herba parva caulescens; caulis 2–4 cm. longis, simplicibus dense foliatis; foliis graminoideis 0.8–3 cm. longis, 2–5 mm. latis, argute acuminatis vel mucronulatis utrinque laxe albo-villosis; vaginis gracilibus arcte adpressis 1–1.5 cm. longis laxe villosis, laminis erectis acuminatis saepe divergentibus; pedunculis gracilibus 3–17 stramineis 4–10 cm. longis, 5-costatis glabris; bracteis involucrantibus oblongis brunneis ad apicem triangulari-acutis dense barbatis; receptaculo longe villoso; bracteis receptaculi brunneis oblanceolatis subacutis dorso villosis ad apicem barbatis; floribus trimeris.

Small caulescent herb; stems abbreviated, 2–4 cm. long, densely leafy, erect, simple; leaves grass-like, light green on both surfaces, 0.8–3 cm. long, 2–5 mm. wide at the base, sharply acuminate or mucronulate at the apex, loosely white-villous on both surfaces, with numerous parallel veins, not fenestrate; sheaths slender, cylindric, closely appressed to the peduncle, equaling the leaves, 1–1.5 cm. long, loosely villous, more sparsely so toward the apex, obliquely split at the apex, the blade firm, erect, acuminate, the apex often slightly divergent; peduncles slender, 3–17 per plant, 4–10 cm. long, stramineous, about 5-costate, twisted, not flattened, glabrous; heads hemispheric, gray, 3–5 mm. wide; involucral bractlets oblong, about 1.8 mm. long and 0.7 mm. wide, triangular-acute at the apex, brown, densely bearded on the back at the slightly incurved apex; receptacle long-villous; receptacular bractlets brownish, oblanceolate, about 2.3 mm. long and 0.7 mm. wide, subacute at apex, villous on the back and bearded at the apex; staminate florets: sepals 3, connate only at the very base, oblanceolate, about 0.7 mm. long and 0.35 mm. wide, brownish, obtuse at the apex, glabrous except for the densely bearded apex; petals 3, united into a very slender hyaline infundibular tube about 0.7 mm. long, separate and involute at the apex, glabrous, the lobes about 0.4 mm. long; stamens 3, very slightly exserted from the corolla-limb; pistillate florets: sepals 3, separate or connate only at the very base, broadly elliptic, about 1.3 mm. long and 0.5 mm. wide, brownish, obtuse at the apex, convex on the back, villous on the upper half and densely bearded at the apex on the back; petals 3, separate, narrow-elliptic, about 1 mm. long and 0.3 mm. wide, obtuse at the apex, brownish, villous on the back from below the middle to the apex, densely bearded at the apex; pistil about 1.3 mm. long, glabrous; ovary 3-celled, 3-ovulate; stigmas 3.

TYPE: locally frequent in damp sand, Kaieteur Savanna, British Guiana, May 5, 1944, *Maguire & Fanshawe 23244*. New York Botanical Garden. The collectors note: "Leaves erect, spreading, to 10 cm." The species resembles *P. Maguirei* in habit, but is smaller in all its parts.

PAEPALANTHUS LEUCOCYANEUS Tutin. BRITISH GUIANA: in muck, Kaieteur Savannas, *23264*. SURINAM: base of escarpment, Tafelberg, *24750*. The species is known only from British Guiana and Surinam.

Paepalanthus Maguirei Moldenke, sp. nov. Herba caulescens; caulis usque ad 8 cm. longis, simplicibus vel furcatis; foliis graminoideis 2–6 cm. longis, 2–6 mm. latis, subacutis multistriatis utrinque glabris nitidis; vaginis arcte adpressis 2–3.5 cm. longis, glabris, laminis erectis acutis parce ciliatis; pedunculis 5–15, gracilibus, stramineis, 10–21 cm. longis, tricostatis, glabris, complanatis; bracteis involucrantibus oblanceolatis, subacutis vel obtusis brunneis, glabris; bracteis receptaculi anguste obovatis, brunneis, obtusis ad apicem barbatis; floribus trimeris.

Caulescent herb; stems slender, to about 8 cm. long, simple or sparingly branched in furcate fashion, ascending; leaves numerous, crowded, rather uniformly bright green on both surfaces, grass-like, 2–6 cm. long, 2–6 mm. wide at the base, subacute at the apex, many-striate with close paralled veins, not fenestrate, glabrous and shiny on both surfaces; sheaths closely appressed to the peduncle, 2–3.5 cm. long, equaling or slightly shorter than the leaves, obliquely split at the apex, glabrous throughout or with a few scattered cilia on the erect acute blade; peduncles 5–15 per branch, slender, erect, stramineous, 10–21 cm. long, 3-costate, glabrous throughout, flat in drying; heads hemispheric or globose, 4–6 mm. long and wide, gray; involucral bractlets oblanceolate, about 1 mm. long and 0.5 mm. wide, rounded or subacute at the apex, brownish throughout, glabrous; receptacular bractlets narrowly obovate, about 1 mm. long and 0.52 mm. wide, rounded at the apex, brownish and bearded at the apex; staminate florets: sepals 3, broadly obovate, connate only at the very base, about 1 mm. long and 0.54 mm. wide, erect, firm, brown on the upper half, rounded and bearded at the apex, darkest at the apex; petals 3, united into a hyaline glabrous obscurely 3-lobed tube; stamens 3, exserted from the petal-tube; anthers 4-celled; pistillate florets: sepals 3, connate only at the very base, obovate, about 2.6 mm. long and 0.7 mm. wide, erect, firm, brownish toward the apex, translucent toward the base, densely villous on the back at the apex; petals 3, separate to the base, hyaline, narrowly oblanceolate, about 1 mm. long and 0.3 mm. wide, densely long-villous on the back, acute at the apex, eglandular; pistil about 1.3 mm. long; style about 0.6 mm. long, glabrous; stigmas 3; ovary subrotund, about 0.5 mm. long and wide, 3-celled.

TYPE: frequent in cracks in rock of stream bed, North Ridge Cascade, mixed high forest, Savanna I, 15–1700 feet altitude, Tafelberg, Surinam, September 8, 1944, *Maguire 24670*. New York Botanical Garden. Other collections are *Maguire 24241*, locally frequent in wet rocky bed of stream at east side of North Ridge, at top of Tafelberg; and *Maguire 24832*, frequent on moist rocks, North Ridge Creek, km. 25.5, Tafelberg. Related to *P. Killipii* and *P. Tatei* Moldenke.

Paepalanthus pauper Moldenke, sp. nov. Herba parva acaulescens; foliis rosulatis linearibus 7–20 mm. longis, non 1 mm. latis, urtinque glabris; vaginis gracillimis arcte adpressis 1.5–2 cm. longis, glabris, laminis erectis arcte adpressis saepe bilobatis; pedunculis solitariis filiformibus, stramineis,

3–7 cm. longis, glabris vel parce glanduloso-pilosis; bractis involucrantibus ellipticis albidis vel hyalinis acutis glabris nitidis; receptaculo dense longeque villoso; bracteis receptaculi late ellipticis hyalinis convexis obtusis glabris vel ad basin longe villosis; floribus trimeris.

Very small acaulescent herb; leaves rosulate, linear, uniformly light green on both surfaces, 7–20 mm. long, less than 1 mm. wide, glabrous on both surfaces, the venation indiscernible; sheaths very slender, cylindric, closely appressed to the peduncle, surpassing the leaves, 1.5–2 cm. long, obliquely split at the apex, glabrous, the blade erect, closely appressed, often bilobed at the apex; peduncles filiform, usually only one per plant, stramineous, 3–7 cm. long, glabrous or with a few scattered widely divergent gland-tipped hairs about 0.5 mm. long toward the apex; heads white, hemispheric, 1–3 mm. wide, few-flowered; involucral bractlets elliptic, whitish or hyaline, about 2 mm. long and 1 mm. wide, acute at the apex, glabrous and shiny; receptacle densely long-villous; receptacular bractlets broadly elliptic, hyaline, convex on the back, about 1.8 mm. long and 1 mm. wide, blunt at the apex, glabrous throughout or long-villous at the very base; staminate florets: sepals 3, connate only at the very base, hyaline, obovate or oblanceolate, about 1.5 mm. long and 0.5 mm. wide, obtuse or emarginate at the apex, glabrous, eglandular, not bearded; petals 3, united into a very slender hyaline infundibular tube, separate and involute at the apex, glabrous; stamens 3, slightly exserted from the corolla-tube; anthers 4-celled; pistillate florets: sepals 3, separate or connate only at the very base, hyaline, narrow-elliptic, about 1.5 mm. long and 0.5 mm. wide, subacute at the apex, loosely villous on the back especially along the margins, not bearded; petals 3, separate, hyaline, oblanceolate, ca. 1 mm. long and 0.3 mm. wide, densely long-villous on the back, not bearded; pistil about 1 mm. long, glabrous; ovary 3-celled, 3-ovulate.

TYPE: locally frequent in sedge bog, Kaieteur Savanna, British Guiana, May 4, 1944, *Maguire & Fanshawe 23206*. New York Botanical Garden. The collectors describe it as a "minute perennial tufted herb 1–2 cm. high; flower spike to 4 cm. high."

PAEPALANTHUS SUBTILIS Miq. BRITISH GUIANA: in white sand of clearing, Kangaruma, *23000*. SURINAM: frequent in sandy soil of open places, islands in Brokoboto Rapids, 3 hours above Pakka Pakka, *23984*. Southern Venezuela, British Guiana, and Surinam to Bahia, Brazil.

Paepalanthus tafelbergensis Moldenke, sp. nov. Herba caulescens; caulis 1–4 cm. longis ad apicem foliatis; foliis graminoideis erectis vel recurvatis 3–6 cm. longis, 2–8 mm. latis, acutis vel submucronulatis multinervatis utrinque glabris; vaginis gracilibus 1.5–3 cm. longis, laxis, glabris, laminis erectis argute acutis vel submucronulato-acuminatis saepe subrecurvatis; pedunculis 12–60 gracilibus 8–22 cm. longis 4-costatis glabris; bracteis involucrantibus late oblongis atrobrunneis vel nigris glabris, ad apicem triangulari-acutis et longe ciliatis; receptaculo dense longeque villoso; bracteis receptaculi oblanceolatis atrobrunneis vel nigris acutis, ad apicem longe ciliatis et dense barbatis; floribus trimeris.

Caulescent herb; stems greatly abbreviated, 1–4 cm. long, leafy only at the apex; leaves grass-like, comparatively few, erect or recurved, 3–6 cm. long, 2–8 mm. wide at the base, acute or submucronulate at the apex, often mostly dried up at time of anthesis, sometimes with a slightly silvery sheen,

many-nerved, not fenestrate, glabrous on both surfaces; sheaths slender, 1.5–3 cm. long, rather loosely enveloping the peduncle, equaling or surpassing the leaves, glabrous, obliquely split at the apex, the blade erect, sharply acute or submucronulate-acuminate, the tip often slightly recurved; peduncles numerous, 12–60 or more per plant, erect, slender, 8–22 cm. long, about 4-costate, glabrous, slightly twisted; heads gray, hemispheric or subglobose, 4–6 mm. wide, densely hairy; involucral bractlets numerous, closely overlapping in several series, broadly oblong, about 2 mm. long and 1 mm. wide, dark brown or black except at the very base, abruptly triangular-acute at the apex, glabrous and shiny on both surfaces except for the long-ciliate apical triangle; receptacle densely long-villous; receptacular bractlets oblanceolate, about 1.5 mm. long and 0.5 mm. wide, dark brown or black throughout, acute at the apex, glabrous on both surfaces except for the long-ciliate and densely bearded apex; staminate florets numerous: sepals 3, connate only at the very base, obovate or oblanceolate, about 1 mm. long and 0.3 mm. wide, dark brown or black except at the connate base, convex on the back toward the apex, rounded at the apex, glabrous on both surfaces except for the densely bearded apex, the hairs stellate-divergent; petals 3, united into a brownish or stramineous slender tube about 1 mm. long, glabrous, free and involute at the apex, eglandular; stamens 3, slightly exserted; pistillate florets few: sepals 3, connate only at the very base, firm, rigid, elliptic, about 1.3 mm. long and 0.5 mm. wide, rounded at the apex, dark brown or black throughout, flat, glabrous on the inner surface, long-villous on the back from below the middle to the densely bearded apex; petals 3, connate only at the very base, rigid, dark brown or black throughout, narrow-elliptic, about 1 mm. long and 0.25 mm. wide, sharply acute or subacuminate at the apex, glabrous on the inner face, densely long-villous on the back from the base to the apex, eglandular; pistil about 1.5 mm. long, glabrous; stigmas 3; ovary 3-celled, 3-ovulate.

TYPE: frequent in sphagnum border of seeps, bed rock, Savanna VIII, Tafelberg, Surinam, August 25, 1944, *Maguire 24485*. New York Botanical Garden.

PAEPALANTHUS VISCOSUS Moldenke. SURINAM: savanna, Zanderij II, *23665;* in sand, south savanna, vicinity Arawak village of Mata, *24979*. Known only from Surinam.

SYNGONANTHUS BIFORMIS (N.E.Br.) Gleason. SURINAM: on banks of Augustus Creek, Tafelberg, *24728*. Known only from Vaupes, Colombia, British Guiana, and Surinam.

SYNGONANTHUS GRACILIS (Körn.) Ruhl. BRITISH GUIANA: in sandy bog, Kaieteur Savanna, *23180, 23181;* in damp sand, Kaieteur Savanna, *23245;* in muck, Kaieteur Savanna, *23246*. SURINAM: frequent, savanna, Zanderij II, *23691;* infrequent, Savanna I, Tafelberg, *24206*. The species in its typical form is known from Colombia, British Guiana, Surinam, and Brazil. The material cited above and in herbaria under this name is very variable in many characters and may not all be properly identified. Floral characters taken from *23691* and *24206* are as follows: involucral bractlets elliptic or elliptic-obovate, about 2 mm. long and 1 mm. wide, very convex on the back, firm but transparent except for the stramineous base, sharply acute at the apex, glabrous except for the slightly ciliate margins at about the middle; receptacle densely long-villous; receptacular bractlets none; staminate florets long-stipitate: sepals 3, hyaline, about 1.4 mm. long and 0.5 mm. wide,

falcate, acute at the apex, glabrous, eglandular; petals 3, connate into a short slender tube much shorter than the sepals; stamens 3; anthers white, 4-celled; pistillate florets short-stipitate: sepals 3, hyaline, elliptic, about 2 mm. long and 0.7 mm. wide, acute at the apex, eglandular, long-villous on both surfaces; petals 3, connate into a slender hyaline tube, about 1 mm. long, the free tips small and involute, long-hirsute on the back and especially so toward the apex; pistil small; ovary about 0.5 mm. long; style about 0.5 mm. long, glabrous, with 3 tiny erect appendages; stigmas 3, simple.

Syngonanthus guianensis Moldenke, sp. nov. Herba parva caulescens; caulis gracilibus furcatis, ramis 1–3 cm. longis dense foliatis; foliis linearibus late divergentibus vel reflexis 3–15 mm. longis, usque ad 1 mm. latis, obtusis, juventute dense longeque villosis, senectute glabrescentibus, revolutis vel subconduplicatis; vaginis gracilibus ca. 1 cm. longis arcte adpressis plusminus longe villosis, laminis erectis vel divergentibus anguste lanceolatis ad marginem longe pilosis; pedunculis 6–20 gracillimis 2-costatis villosis; bracteis involucrantibus late spathulatis brunneis convexis rotundatis glabris; receptaculo longe villoso; bracteis receptaculi obovatis convexis brunneis obtusis barbatis; floribus trimeris.

Small caulescent herb to about 8 cm. tall; stems slender, branched, the branches 1–3 cm. long, densely leafy; leaves linear, widely divergent or reflexed, 3–15 mm. long, 1 mm. or less wide at the base, the lowest ones on each stem or branch much smaller than the upper ones, blunt at the apex, densely long-villous when young, more sparsely so in age or glabrescent, firm-textured, mostly more or less revolute-margined above the base sometimes almost conduplicate toward the apex, the venation not discernible; sheaths slender, twisted, striate, about 1 cm. long, closely enveloping the peduncle, more or less long-villous with scattered white hairs, noticeably humped at the mouth and prolonged on one side into an erect or divergent, slender, blunt-tipped, narrow-lanceolate blade which is more or less long-pilose along the margins; peduncles very slender, erect, 6–20 per branch, 2-costate, slightly twisted, more or less densely villous with long white appressed or somewhat divergent hairs; heads white, hemispheric, 1.5–4 mm. wide; involucral bractlets broadly spatulate, brown throughout, about 1.5 mm. long and 1 mm. wide, rounded at the apex, somewhat convex on the back, glabrous on both surfaces, not bearded; receptacle long-villous; receptacular bractlets obovate, very convex on the back, about 1 mm. long and 0.7 mm. wide, brown throughout, rounded at the apex, glabrous on both surfaces except for the densely bearded apex; staminate florets numerous: sepals 3, connate only at the very base, erect, rigid, dark brown except at the very base, oblanceolate, about 1 mm. long and 0.26 mm. wide, rounded at the apex, glabrous on both surfaces, not bearded; petals 3, united into a slender stramineous glabrous tube about 0.9 mm. long, the lobes linear, erect, firm, about 0.2 mm. long, not involute; stamens 3, slightly exserted; pistillate florets: sepals 3, connate only at the very base, narrow-elliptic, stramineous or subhyaline, about 1 mm. long and 0.3 mm. wide, subacute at the apex, glabrous throughout, not bearded; petals 3, stramineous or light brown, free at the base and apex, connate at the middle into a slender tube, glabrous, eglandular; ovary 3-celled, glabrous.

TYPE: Kaieteur Savanna, British Guiana, May 4, 1944, *Maguire & Fanshawe 23236*. New York Botanical Garden. Another collection from the same locality is *Maguire & Fanshawe 23182*, described as locally frequent, annual,

short-stemmed herb with canescent leaves. The species superficially greatly resembles *Blastocaulon rupestre* (Gardn.) Ruhl. of Minas Geraes, Brazil.

Syngonanthus savannarum Moldenke, sp. nov. Herba parva caulescens; caulis 3–7 cm. longis valde furcatis dense foliatis; foliis linearibus rigidis recurvatis ca. 1 cm. longis, usque ad 1 mm. latis, ad basin et marginem juventute plusminus dense albido-villosis, senectute glabrescentibus nitidis; vaginis gracilibus ca. 7 mm. longis arcte adpressis plusminus villosulis vel glabratis, laminis firmis erectis acutis, ad basin dense villoso-marginatis; pedunculis gracilibus 3–5 cm. longis villosulis; bracteis involucrantibus arcte imbricatis obovatis brunneis convexis obtusis glabris nitidis; receptaculo dense villoso; bracteis receptaculi oblongis stramineis acutis, versus apicem longe villosis; floribus trimeris.

Small caulescent herb, perennial, growing in tufts to 20 cm. in diameter, to 10 cm. tall; stems conspicuous, 3–7 cm. long, several-branched in dichotomous fashion from the base, densely and equally foliose throughout; leaves linear, firm and rigid, recurved, bright green on both surfaces, about 1 cm. long, 1 mm. or less wide, ampliate and clasping the stem at base, glabrous and shiny on both surfaces or more or less densely white-villous at the base and along the margins when young, blunt at the apex, the venation not discernible; sheaths slender, about 7 mm. long, not plainly costate nor twisted, closely enveloping the peduncle, glabrate below or more or less villosulous with scattered hairs, obliquely split at the apex and usually densely villous-margined there, the blade firm, erect, acute; peduncles slender, one or several per branch, borne in axils considerably below the apex, 3–5 cm. long, densely villosulous when young with long white more or less appressed hairs, less so in age; heads grayish-brown, hemispheric, 2–6 mm. wide; involucral bractlets in several series, closely overlapping, the outermost much smaller than the inner, obovate, brown throughout, very convex on the back, the largest about 1.5 mm. long and 1 mm. wide, rounded at the apex, glabrous and shiny on both surfaces; receptacle densely villous; receptacular bractlets oblong, stramineous, about 1.5 mm. long and 0.5 mm. wide, with hyaline margins, acute at the apex, very densely long-villous at and near the apex; staminate florets numerous: sepals 3, erect, connate only at the base, firm, brown throughout, oblanceolate, 1.3–1.5 mm. long, about 0.4 mm. wide, acute at the apex, glabrous on both surfaces, eglandular, not bearded; petals 3, united into a slender stramineous or subhyaline tube about 1.3 mm. long, glabrous, free at the apex, the lobes erect, hyaline, about 0.5 mm. long; stamens 3; pistillate florets few: sepals 3, connate only at the base, hyaline, narrow-elliptic, about 1.5 mm. long and 0.3 mm. wide, acute at the apex, glabrous on both surfaces, not bearded, eglandular; petals 3, connate at the middle into a slender tube, glabrous; pistil about 1.6 mm. long, glabrous; stigmas 3; ovary very small, glabrous, 3-celled.

TYPE: locally frequent on damp sand, Kaieteur Savanna, British Guiana, May 6, 1944, *Maguire & Fanshawe 23280*. New York Botanical Garden. The species has much of the general aspect of *Paepalanthus Glaziovii* Ruhl. of Minas Geraes, Brazil.

SYNGONANTHUS SIMPLEX (Miq.) Ruhl. BRITISH GUIANA: in sedge bog, Kaieteur Savanna, *23219; 23206a*. Venezuela, British Guiana, and Surinam.

Syngonanthus surinamensis Moldenke, sp. nov. Herba caulescens; caulis 1–7 cm. longis simplicibus dense arachnoideo-pubescentibus dense foliatis; foliis linearibus divergentibus vel reflexis 2–5 cm. longis, usque ad

1 mm. latis, argute acutis vel mucronulatis utrinque glabris; vaginis gracillimis arcte adpressis 4–4.5 cm. longis costatis glabris, laminis erectis argute acutis; pedunculis 2–7 gracillimis stramineis 18–25 cm. longis tricostatis glabris nitidis vel ad apicem adpresso-pilosis; capitulis albis perspicue proliferatis; bracteis involucrantibus ellipticis vel obovatis stramineis vel versus apicem hyalinis convexis subacutis vel obtusis utrinque glabris; receptaculo dense longeque villoso; bracteis receptaculi nullis; floribus trimeris.

Caulescent herb; stems 1–7 cm. long, simple, ascending, densely arachnoid-pubescent with white matted hairs, most conspicuous on the youngest parts, densely foliose; leaves linear, uniformly bright green on both surfaces, divergent or eventually reflexed, 2–5 cm. long, 1 mm. or less wide, slightly ampliate at the base, with a prominulent midrib, sharply acute or mucronulate at the apex, glabrous on both surfaces, not fenestrate; sheaths very slender, closely enveloping the peduncle, usually somewhat surpassing the leaves, 4–4.5 cm. long, twisted, several-costate, glabrous, obliquely split at the apex, the blade erect, sharply acute, not divergent; peduncles 2–7 per plant, very slender, stramineous, 18–25 cm. long, 3-costate, glabrous and shiny except at the obscurely appressed-pilose apex; heads white, hemispheric, 4–6 mm. wide, mostly more or less proliferating with a varying number of reduced leaves 7–15 mm. long or abbreviated leafy matted arachnoid stems to 1 cm. long; involucral bractlets elliptic or obovate, stramineous toward the base, otherwise hyaline, very convex on the back, about 1.5 mm. long, 0.5–1 mm. wide, rounded or subacute at the apex, glabrous on both surfaces, not bearded; receptacle densely long-villous; receptacular bractlets absent; staminate florets: sepals 3, free, hyaline, elliptic, about 1.5 mm. long and 0.5 mm. wide, subacute at the apex, glabrous on both surfaces, not bearded, usually much surpassed by the corolla; petals 3, united into a slender infundibular tube 1–1.8 mm. long, free at the apex, the lobes erect, hyaline, broadly elliptic, about 1 mm. long; stamens 3; anthers white, 4-locular; pistillate florets: sepals 3, free, hyaline, narrow-elliptic, about 2 mm. long and 0.5 mm. wide, subacute at the apex, glabrous on both surfaces, not bearded; petals 3, hyaline, about 2 mm. long, glabrous, united at the middle into a tube about 1 mm. long, free at the apex, eglandular, not bearded; pistil about 1.5 mm. long, glabrous; ovary very small.

TYPE: locally frequent on wet dripping cliffs 200 meters west of Grace Falls, Tafelberg, Surinam, August 26, 1944, *Maguire 24502*, New York Botanical Garden. Another collection is *Maguire 24321*, locally frequent, with long peduncles, under heavy drip, opening high bush, base of north escarpment, 300 meters, Tafelberg.

SYNGONANTHUS TRICOSTATUS Gleason. BRITISH GUIANA: in sedge bog, Kaieteur Plateau, *23113*. British Guiana and Southern Venezuela.

SYNGONANTHUS UMBELLATUS (Lam.) Ruhl. BRITISH GUIANA: in damp sand, Kaieteur Savanna, *23252*. SURINAM: in wet places, Tafelberg, *24380;* common in moist sand along railroad near Km. 70, *23645;* frequent, grass savanna, Zanderij II, *23662*. The species in this typical form is distributed from Vaupes, Colombia, Venezuela, and the Guianas to Minas Geraes, Brazil.

TONINA FLUVIATILIS Aubl. SURINAM: in ditch, savanna, vicinity of Sectie O, km. 68, *25025*. Nicaragua, Cuba, Trinidad, and from Colombia, Venezuela, and the Guianas to eastern Peru and central Brazil.

RAPATEACEAE

CEPHALOSTEMON AFFINIS Koernicke. SURINAM: infrequent, shallow bogs, periphery Savanna I, Tafelberg, *24204;* frequent; wet places, Savanna IV, Tafelberg, *24370*. Previously known only from the type locality, Esmeralda, Venezuela.

POTAROPHYTUM RIPARIUM Sandwith. BRITISH GUIANA: flowers yellow, heads mucilaginous, stems sigmoid in cross-section at base, locally frequent, boggy places along stream, vicinity Potaro River landing, Kaieteur Plateau, *23396*. Known only from the type locality.

RAPATEA PALUDOSA Aubl. var. **paludosa** Maguire, var. nov. *R. paludosa* Aubl. Pl. Gui. **1**: 305, *pl. 118*. 1775. BRITISH GUIANA: perennial herb to 2 m. high, occasional, swampy ground, Amatuk Portage, Potaro River Gorge, *23016;* flower yellow, stem base sigmoid in cross-section, marshy area by stream, Tukeit, Potaro River Gorge, *23546*. SURINAM: frequent, swampy bush east of savanna, Zanderij I, *25044*. Swamp herbs of low altitudes, Venezuela and Colombia to Pará and Amazonas.

RAPATEA PALUDOSA Aubl. var. **sessiliflora** Maguire, var. nov. A var. *paludosa* similis, sed foliis angustioribus; bracteis angustioribus, floribus plus-minus sessilibus.

Similar to the var. *paludosa* but with leaves 1.0–2.5 (3.5) cm. wide, bracts 2.0–2.5 (3.2) cm. wide, and flowers essentially sessile.

TYPE: common, wet, open, dakama bush, Grace Creek, 1 mile east of Savanna VIII, Tafelberg, Surinam, September 1, 1944, *Maguire 24587*. New York Botanical Garden. Cotype: dakama forest, vicinity Black Water Camp (5), Coppenam River Headwaters, 106 meters altitude, July 26, 1944, *Maguire 24177*, at the base of Tafelberg, frequent and occurring to the exclusion of the broad-leaved form; one further collection seen belongs here, viz.; in vicinibus Barra [Manaos], Prov. Rio Nigro [Brazil], Dec.—Mart. 1850–51. *R. Spruce*.

The var. *sessiliflora* is certainly a part of *R. paludosa*, differing only qualitatively in width of leaves, 1.0–2.5 (3.5) as against (3.5) 4.0–9.0 cm., and in width of bracts, 2.0–2.5 (3.2) cm. as against (3.0) 4.0–6.0 cm. in the var. *paludosa*. The most conspicuous difference lies in the length of pedicels, which in var. *sessiliflora* are sessile, subsessile, or occasionally as much as 3 mm. long, while in the typical variety they vary from 5–12 (20) mm. long. Further, the var. *paludosa* is characteristically a plant of low altitude, boggy or swampy areas, while on Tafelberg the entire, generally distributed population consists exclusively of the narrow-leave variant.

R. linearis Gleason apparently is derived from *R. paludosa*, and is superficially similar to the var. *sessiliflora*, but differs essentially in more narrow, gradually attenuate, less prominently nerved sepals.

RAPATEA XIPHOIDES Sandwith. BRITISH GUIANA: locally frequent, boggy places, Kaieteur Plateau, *23297*. Known only from the type locality.

SAXO-FRIDERICIA REGALIS Schomb. BRITISH GUIANA: common, damp sand or sphagnum, borders of bush islands, Kaieteur Savanna, *23330*. SURINAM: flowers yellow, inflorescence and base of stems copiously gelatinous, frequent, border of *Clusia* bush, Savanna VIII, Tafelberg, *24571*. Previously known only from the Mt. Roraima and Kaieteur Plateau regions.

SPATHANTHUS JENMANI N. E. Brown. BRITISH GUIANA: locally common on white sand, wet places, secondary forest, Amatuk Portage, Potaro River,

23015; same data as for preceding, *23547*. Apparently endemic and limited to Amatuk and Warratuk Falls, Potaro River.

SPATHANTHUS UNILATERALIS Desv. SURINAM: frequent, swampy bush, Zanderij II, *23703;* frequent, swamps, vicinity Kwatta hede, Saramacca River, *23917*. Generally distributed: British Guiana, Surinam, French Guiana, Pará, and Amazonas.

STEGIOLEPIS ANGUSTATA Gleason. BRITISH GUIANA: frequent, boggy places in sand or sphagnum, border bush islands, Kaieteur Savanna, *23261*. Known only from the Kaieteur Plateau.

STEGIOLEPIS FERRUGINEA Bakerm. BRITISH GUIANA: frequent, wet places, Kaieteur Savanna, *23320*. Known only from the Kurupung Mountains, and the Kaieteur Plateau, British Guiana.

BROMELIACEAE[30]

Since my publication of "The Bromeliaceae of British Guiana" (Contr. Gray Herb. **89**: 46–86. 1930.) I have seen very little material from any of the Guianas until the present collection came to me. Originally I followed Mez's sequence of tribes or subfamilies, but have changed to Harm's as better expressing the lines of evolution within the family.

Subfamily I. Pitcairnioideae (including Navioideae)

LINDMANIA GUIANENSIS (Beer) Mez. BRITISH GUIANA: perennial bulbous herb 1.6 m. high, basal leaves recurved, flowers white, Kaieteur Plateau, *23158*. The type was collected by Schomburgk on the upper Corentyne River and until now was the only material known.

NAVIA ANGUSTIFOLIA (Bak.) Mez. BRITISH GUIANA: light green leaves, fruit bodies usually lateral, occasionally terminal, from dry rock shelf, 1 mile below Kaieteur Falls, Potaro River Gorge, *23435*. Sandwith (*1285*) col-

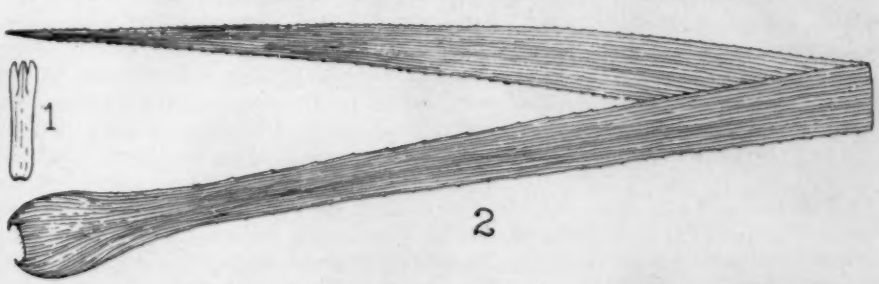

FIG. 14. *Navia Maguirei* L. B. Smith. *Maguire 24575*. 1. sepals. × 1. 2. leaf. × 1.

lected it at the head of the falls. The type was collected by Appun at Mt. Marima (Maringma of later maps) just east of Roraima.

Navia Maguirei L. B. Smith, sp. nov. Fig. 14. Herba caulescens, caulibus ramosis, 22 cm. vel. ultra longis; folia dense polystiche ordinata, margine sparse serrulata et sparsissima lepidota, mox omnino glabra, vaginis ovatis, brevibus, laminis linearibus, acuminatis, ad 25 cm. longis, 9.5 mm. latis, basi angustatis; inflorescentia dense angusteque ovoidea, acuta, per anthesin in

[30] By Lyman B. Smith.

foliorum centro nidulans sed mox ramo sympodialiter superata, 8–9 mm. diametro, glabra, bracteis primariis lineari-laminatis, inflorescentiam plerumque superantibus, bracteis florigeris anguste ovatis, acutis, sepala paulo superantibus; flores sessiles; sepala alte connata, 16 mm. longa, laminis ellipticis, acutis, 4.5 mm. longis, anteriori plana a posterioribus carinatis inclusa; petala alba, quam sepala 7–8 mm. longiora, stamina verisimiliter subaequantia sed recurvata, apice involuto-subulata; ovarium omnino superum.

TYPE: north of Savanna VIII, Tafelberg, Surinam, August 29, 1944, *Maguire 24575*. For habitat see Geogr. Rev. **35**: 574, fig. 11 (1945). In its subpetiolate leaves and highly connate sepals it closely resembles *Navia Gleasonii*, the nearest species to it geographically, but these leaves are serrulate throughout where those of *N. Gleasonii* are nearly entire with only a few teeth at the base of the blade.

NAVIA MAGUIREI var. **minor** L. B. Smith, var. nov. Differt in partibus omnibus minora; caulis brevis, 6–10 cm. longus; folia infra 20 cm. longa et 5 mm. lata; sepala 10 mm longa.

TYPE: common, wet or dry walls, or on soil beneath north escarpment, Tafelberg, Surinam, August 11, 1944, *Maguire 24334*. According to Maguire, the difference in size between this and the typical variety is constant and striking, but there is no difference in the form of the parts that would warrant specific segregation.

BROCCHINIA REDUCTA Bak. (Contr. Gray Herb. **89**: 61). BRITISH GUIANA: perennial herb with woody rootstock, sheathing leaves hollow-cylindroid, fruit greenish-yellow, dominant locally on savannas, Kaieteur Plateau, *23198*. This material from at least the same general region as the type accords very closely with it in its very slender scape (ca. 2 mm.), small remote scape-bracts, and short few-branched inflorescence.

BROCCHINIA MICRANTHA (Bak.) Mez. (Contr. Gray Herb. **89**: 62). BRITISH GUIANA: abundant, dominant, fleshy perennial, stem to 2 m., 15 cm. diam., leaves crowded at apex, floral shoot 2.6 m., branches to 1 m. long, inflorescence pale cream, flowers brownish, Kaieteur Savanna, *23300*. Also from the type region and the first material of the species we have had in the United States. The collection is very ample and makes helpful comparison with later species like *B. Tatei* (Contr. Gray Herb. **161**: 29), and the notes[31] indicate a considerably larger plant in all its parts than has been recorded heretofore.

PITCAIRNIA NUDA Bak. (Contr. Gray Herb. **89**: 64). SURINAM: common, rocks, Savanna VIII, Tafelberg, *24460*. Previously known only from south-central British Guiana, the type, *Appun 1582*, from Rapunnunie (Rupununi River), *A. C. Smith 3644*, from the Kanuku Mountains through which the Rupununi flows, and the upper Tapanahoni River, Surinam. Smith records the flowering plants as 2 m. high.

PITCAIRNIA MAIDIFOLIA (Morr.) Dene. (Contr. Gray Herb. **89**: 64, under *P. Funckiana*). BRITISH GUIANA: occasional, terrestrial to 1.5 m. high, bracts scarlet, apically green, flowers pale greenish, Kaieteur Savanna, *23411*. SURINAM: frequent, south escarpment, Arrowhead Basin, Tafelberg, *24509*.

[31] Indeed, this striking giant bromeliad may, in its stem and crown of leaves alone, well exceed 6 or 7 meters in height. It, perhaps more than any other plant, dominates the vegetation of the Kaieteur escarpment, and certainly more vividly than any other impresses itself on the mind of the visitor to this spectacular region. B. M.

Also known from Venezuela, Colombia, and Costa Rica. In cultivation for almost a century.

Subfamily II. Tillandsioideae

?TILLANDSIA TRITICEA Burchell (Contr. Gray Herb. **89**: 25, 73). BRITISH GUIANA: frequent, epiphytic, mora forests, Kamuni Creek, Groete Creek, Essequibo River, *22822*, material too fragmentary for certain determination. Brazil to Peru, Trinidad and Colombia.

TILLANDSIA BULBOSA Hook. (Contr. Gray Herb. **89**: 74). BRITISH GUIANA: occasional, from *Sapodilla* tree, river tidal flats, Mazaruni Forest Station, *23580*. Widely distributed in British Guiana and elsewhere in tropical America at low elevations.

VRIESIA SPLENDENS (Brongn.) Lem. *V. longibracteata* (Bak.) Mez. (Contr. Gray Herb. **89**: 68). BRITISH GUIANA: frequent, leaves zebroid, alternate bands of red-brown and green, bracts scarlet, Kaieteur Savannas, *23331*. Surinam: frequent, terrestrial, leaves purple-brown barred, talus base of Arrowhead Basin, Tafelberg, *24482*. One of the showiest of bromeliads, in cultivation for a century; French Guiana. According to Maguire, the bracts in a single colony show all gradations from scarlet to green, thus removing from *V. longibracteata* its chief claim to distinction.

VRIESIA VIRIDIFLORA (Regel) Wittm. ex Mez (Lilloa **6**: 405). BRITISH GUIANA: frequent, leaves bronze, Kaieteur Savanna, *23332*. North Western District, Costa Rica.

VRIESIA PROCERA (Mart.) Wittm. (Contr. Gray Herb. **89**: 69). BRITISH GUIANA: common, on a *Sapodilla* tree, flowers yellow, bracts yellow-green, part suffused red, river tidal flats, Mazaruni Forest Station, *23579*. Demerara, Surinam, eastern Brazil.

GUZMANIA ALTSONII L. B. Smith. (Contr. Gray Herb. **89**: 7). BRITISH GUIANA: frequent, terrestrial, to 1 m. high, bracts green, red-margined, from wallaba forest, Kaieteur Savanna, *23410*. SURINAM: frequent, terrestrial, moist high and open bush, northeast of Savanna II, Tafelberg, *24404*. First collections since the type, which was from Kaieteur Plateau. Add information as follows: leaves over 8 dm. long, 5 cm. wide, capsule cylindric, 3 cm. long, coma red-brown.

CATOPSIS BERTERONIANA (Schult.) Mez. (Contr. Gray Herb. **89**: 70). BRITISH GUIANA: occasional, epiphytic on low tree, fruit yellow-green, Kaieteur Savanna, *23265*. Essequibo, southern Florida, Central America, West Indies, eastern Brazil.

Subfamily III. Bromelioideae

ARAEOCOCCUS MICRANTHUS Brongn. (Contr. Gray Herb. **89**: 53). BRITISH GUIANA: frequent, epiphyte, mora forests, Kamuni Creek, Groete Creek, Essequibo River, *22884*. SURINAM: epiphyte, ants' nest, tree overhanging Tafelberg Creek, Saramacca River Headwaters, *24901*. General throughout the Guianas, Trinidad, Tobago, Amazon Basin.

AECHMEA MERTENSII (Meyer) Schult. *Ae. mucroniflora* Hook. (Contr. Gray Herb. **89**: 57). BRITISH GUIANA: frequent, mora forests, Kamuni Creek, Groete Creek, Essequibo River, *22824*. General in the Guianas, Trinidad, Amazon Basin.

AECHMEA BROMELIAEFOLIA (Rudge) Bak. (Contr. Gray Herb. **89**: 59). SURINAM: dense wet transition low-high bush north of Savanna II, Tafel-

berg, *24276*. General in the Guianas, British Honduras and Guatemala, Colombia, Venezuela, Trinidad, eastern Brazil, Bolivia, northeastern Argentina.

COMMELINACEAE

ATHYROCARPUS RUFIPES (Seub.) Standl. SURINAM: a specimen without data, but presumably collected at the base of Tafelberg. Apparently unreported from the Guianas; forests, Central America to Brazil and Peru.

DICHORISANDRA HEXANDRA (Aubl.) Kuntze. BRITISH GUIANA: stoloniferous, creeping, ascendent, flowers blue, rare under high mixed forest, Kaieteur Gorge, *23521;* procumbent fleshy herb, gregarious on rocks with species of fern and *Costus;* leaves thinly fleshy, basally sheathing; flowers in bracteate capitula on long axillary peduncles, white, scarcely opening, Takutu Creek to Puruni River, Mazaruni River, *F2084*. SURINAM: flowers deep blue, fruit deep red, frequent, second growth jungle, Charlesburg Rift, 3 km. north Paramaribo, *22788;* petals deep blue with white bases, fruit purple, frequent, edge of forest, Jacob kondre, Saramacca River, *23889;* buds bright red-purple, flowers bicolored, violet and white, frequent, scandent on branches overhanging Tafelberg Creek, Saramacca River Headwaters, *24898*. Widely distributed in tropical America.

TRADESCANTIA GENICULATA Jacq. BRITISH GUIANA: procumbent herb, riverside, Mabaruma, Aruka River, N.W.D., *F2389*. SURINAM: flowers white, common in primary jungle, Charlesburg Rift, 3 km. north Paramaribo, *22804*. Widely distributed in tropical America from Mexico to the West Indies, Brazil, and Peru.

THURNIACEAE

THURNIA SPHAEROCEPHALA (Rudge) Hook. f. BRITISH GUIANA: occasional, bog in secondary forest, Amatuk Portage, Potaro River, *23014;* flowers green, in spherical heads, occasional, sandy stream bed, Kaieteur Savanna, *23298;* locally frequent, Warratuk Portage, Potaro River, *23540;* Amatuk Portage, Potaro River, *23544*. SURINAM: in shallow running water, Krappa Camp (2), Saramacca River Headwaters, *24885*. British Guiana, northern Brazil.

LILIACEAE[32]

SMILAX CUMANENSIS H.B.K. SURINAM: infrequent unarmed vine, flower greenish or purple, white striped within, fruit blue, river bank, vicinity Saron Creek, Saramacca River, *23770, 23772*. West Indies, Venezuela, Colombia, Peru, Guiana. Frequent throughout Surinam.

SMILAX sp. SURINAM: frequent vine, leaves coriaceous, flowers greenish, low bush, big savanna, table top, near North Escarpment, Tafelberg, *24184;* frequent, vine, flowers greenish, in shrubs, Savanna II, Tafelberg, *24254*. Nearly allied to *S. cumanensis*, but with narrow, coriaceous leaves.

SMILAX SCHOMBURGKIANA Kunth. SURINAM: infrequent, fruit red, river banks vicinity Jacob kondre, Saramacca River, *23830*. Throughout Surinam, but apparently less common than *S. cumanensis;* Guiana.

SMILAX KUNTHII Killip & Morton (*S. floribunda* Kunth.). SURINAM: frequent, climbing to 10 m., precipitous east-facing slopes above escarpment, 300 m. south of East Ridge, Tafelberg, *24551*. Mountains of Costa Rica, Peru, and Bolivia. In Surinam also collected on the Hendrik top.

[32] By G. J. H. Amshoff. Preliminary report.

SMILAX sp. SURINAM: frequent, drier places, base of North Escarpment, Tafelberg, *24319;* frequent, fruit red, low bush 1.5 km. west of Savanna IV, Tafelberg, *24411;* frequent, inflorescence reddish, ♂ flower reddish, medium bush, 1.5 km. south of East Ridge, *24591.* First collection in Surinam. To be compared with *S. cuspidata* Poir. from French Guiana.

SMILAX sp. BRITISH GUIANA: occasional vine, fruit globose, green, smooth, red when ripe, Kaieteur Plateau, *23299.* This species has been collected in British Guiana (*Sandwith 1571; F.D. 4007*), and in Surinam (in the Brownsberg forest reserve). It is very distinct because of its accrescent vaginal sheaths and may be identical with the insufficiently known *S. syphilitica* Willd. (Orinoco River), the only species in which this feature is described.

HAEMODORACEAE[33]

XIPHIDIUM COERULEUM Aubl. SURINAM: frequent, dense bush along stream and trail near Jacob kondre, Saramacca River, *23870;* frequent, primary jungle near Posoegronoe, Saramacca River, *24027;* cultivated, Agricultural Experiment Station, Paramaribo, *22768.* West Indies, tropical South America; common throughout Surinam.

DIOSCOREAE[34]

DIOSCOREA AMAZONUM Griseb. SURINAM: frequent, vine, flowers purple, in rather open savanna bush, along railroad near Km. 70, *23616.* Guiana, Amazonian district; frequent throughout Surinam.

DIOSCOREA TRICHANTHERA Gleason. BRITISH GUIANA: occasional, vine from *Aniba excelsa,* flowers in axillary pendent spikes, yellow-brown, in wallaba forest, Kaieteur Plateau, *23238.* Known only from British Guiana.

DIOSCOREA POLYGONOIDES Humb. & Bonpl. BRITISH GUIANA: rocky lateritic soil from dolerite dyke, Garraway Stream, Potato River, *22987a.* Central America, West Indies, tropical South America; frequent.

MUSACEAE[35]

HELICONIA ACUMINATA L. C. Rich. BRITISH GUIANA: perennial, bracts keeled, scarlet, flowers green, locally frequent, Kaieteur Savanna, *23322.* SURINAM: bracts red, flowers green, fruit blue, frequent, shaded low wet bush, river banks above Kwatta hede, Saramacca River, *23949;* bracts red, frequent, northeast of Savanna II, Tafelberg, *24406.* Venezuela, Guiana, Amazonian district. Common in Guiana.

HELICONIA sp. (cf. *H. Psittacorum* L.f.). BRITISH GUIANA: perennial herb to 3 m. high, pedicels long-sheathed, inflorescence and keeled bracts pruinose, flowers orange, rocky lateritic soil, Garroway Stream, Potaro River, *22970.*

ZINGIBERACEAE[36]

COSTUS CYLINDRICUS Jacq. SURINAM: perennial, stems spiraling, bracts red, frequent, border of forest, Kwatta hede, Saramacca River, *23926.*

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[33] By G. J. H. Amshoff.
[34] By G. J. H. Amshoff.
[35] By G. J. H. Amshoff. Preliminary report.
[36] By G. J. H. Amshoff. Preliminary report.

RENEALMIA OCCIDENTALIS (Sw.) Sweet. BRITISH GUIANA: to 2 m., occasional, swampy area, mora and mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22834*. SURINAM: infrequent, pina swamp, vicinity camp no. 3, Saramacca River, *24149*. West Indies, Venezuela, Colombia, Guiana.

RENEALMIA PEDICELLARIS Gleason. SURINAM: inflorescence prostrate, spreading from base, arils orange, frequent, primary jungle, near village of Posoegronoe, *24022*. The same species has been collected by Tulleken, no. 464(L), along the upper Nickerie River. Known otherwise only by the type, *Gleason 138*, Tunatumari, and *Gleason 626*, Rockstone, both from British Guiana.

RENEALMIA MONOSPERMA Miq. SURINAM: fruit red, rare, grass savanna, Zanderij II, *23704;* infrequent, pina swamp, vicinity camp no. 3, Saramacca River, *24147*. This species, in our herbarium represented by the type, *Kegel 1470*, only, has been consequently neglected by monographers. It has to be compared with *R. humilis* Peters. The fruit is 1-seeded, (in the type), or 3-seeded.

RENEALMIA sp. SURINAM: perennial herb, flowers yellow, reddish base, medium bush, 1.5 km. south of East Ridge, Tafelberg, *24597*. Allied to *R. chrysotricha* Petersen. The same species has been collected on the Hendrik top at 1080 m. (*B. W. 5697*).

MARANTACEAE[37]

CALATHERA CYCLOPHORA Baker. BRITISH GUIANA: frequent, open bush, high mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22851;* perennial, leaves crimson below, bracts cyclic, greenish, flowers whitish, occasional, Kaieteur Savannas, *23321*.

CALATHEA ELLIPTICA (Rosc.) K. Schum. SURINAM: common, Charlesburg Rift, primary jungle bordered on both sides by swamps and marshes, 3 km. north of Paramaribo, *22806*. Surinam and British Guiana, frequent.

CALATHEA GRANDIS Peters. SURINAM: flowers cream, frequent, Charlesburg Rift, primary jungle bordered on both sides by swamps and marshes, 3 km. north of Paramaribo, *22805*. Compared with the type specimen, *Wullschlägel 516* (BR), also collected near Paramaribo. A third specimen has been collected by Focke [no. 893, named *C. alluia* (Aubl.) Lindley by Pulle, Enum. 110 (1906)] near Ornamibo. Otherwise, the species is not represented in our Surinam collections and no data about its occurrence in other countries are known to me.

MARANTA ARUNDINACEA L. SURINAM: flowers white, fragile, infrequent, bush to rear of village Jacob kondre, Saramacca River, *23890*. Common throughout the tropics.

MONOTAGMA PARKERI (Roscoe) K. Schum. BRITISH GUIANA: perennial, leaves erect, flowers pale pink, occasional herb from wallaba forest, Kaieteur Plateau, *23329*. SURINAM: locally common, hill, mixed wallaba forest, vicinity Base Camp, Tafelberg Creek, *24118;* flowers white, lower lip pink, frequent, swamps, bush near Kwatta hede, Saramacca River, *23918*. Guiana, Peru; frequent in Surinam.

MONOTAGMA GUIANENSE (Koern.) K. Schum. SURINAM: savanna, east side, Zanderij I, *25058*. The specimen quite agrees with *Splitgerber 289* (L.), determined by the monographer K. Schumann as *M. guianense* (Koern.) K.

[37] By G. J. H. Amshoff. Preliminary report.

Schum. It is, however, possibly only a form of *M. plurispicatum* (Koern.) K. Schum., described by K. Schumann in Engler, Das Pflanzenreich IV **48**: 169 (1902) as "maxine affinis." To *M. guianense* (Koern.) K. Schum. also belong *Kappler 1335* and *Wullschlägel 1135* and *520* (BR), cited by Petersen in Martius, Fl. Bras. 3[3]: 132, *pl. 34* (1890) under *I. laxum* (P. & E.) Koern., a quite distinct Peruvian species. The Brazilian specimens cited by Petersen belong according to Schumann (l. c.) to *M. plurispicatum* (Koern.) K. Schum.; Schumann has unfortunately not examined the Surinam specimens.

THALIA GENICULATA L. SURINAM: marsh herb to 5 dm., bracts green, broadly purple-tipped, flowers white, frequent in water, coastal jungle, road to Carl Francois along Saramacca River, 40 km. from Paramaribo, *23593*. Tropical and subtropical America and Africa; frequent in Surinam.

ISCHNOSIPHON FOLIACEUS Gleason. BRITISH GUIANA: perennial herb, bracts pale pink, flowers white, occasional, Dicymbe forest, trail from Kaiatuk to Tukeit, *23477*. Endemic.

ISCHNOSIPHON GRACILIS (Rudge) Koern. BRITISH GUIANA: scandent to 10 m. long, branched at each node, flowers pink and yellow, locally common, secondary forest, Kaieteur Plateau, *23323*. Guiana, northern Brazil, Peru.

ISCHNOSIPHON OBLIQUUS (Rudge) Koern. BRITISH GUIANA: openings and thickets, frequent, wet soil, Kamuni Creek, Groete Creek, Essequibo River, *22923*. Guiana, Brazil, Colombia, Peru, Martinique; frequent in Guiana.

BURMANNIACEAE[38]

Tribus Burmannieae

Subtribus *Euburmannieae*

BURMANNIA CAPITATA (J. F. Gmel.) Mart. (69). Slender herb with a capitate inflorescence at the apex of the usually unbranched stem, flowers wingless, mostly white or pale cream. BRITISH GUIANA: on wet sand, rare, *23283*. SURINAM: grass savanna, Zanderij II, *23681;* savanna, frequent, Zanderij I, *23723;* rare, Savanna I, Tafelberg, *24205*. A common American species, known from the Southern United States to Bolivia and Paraguay. As discussed by Sprague in Kew Bull. **1939**: 331, the correct citation of author names is: (J. F. Gmel.) Mart., and not: (Walt.) Mart. as cited in my monograph.

BURMANNIA BICOLOR Mart. (89). Unbranched herb with 1–6, blue, violet, or white, often yellow-tipped, prominently 3-winged flowers at the apex of the stem. BRITISH GUIANA: rare, moist sand, Kaieteur Plateau, *23282*. SURINAM: grass savanna, Zanderij II, *23680;* wet places, frequent, Savanna II, Tafelberg, *24227;* frequent, northern part of Savanna IV, Tafelberg, *24371*. Known from Cuba, Venezuela, Guiana, and Brazil.

BURMANNIA TENELLA Benth. (77). BRITISH GUIANA: delicate colorless saprophyte from leaf mold, flowers white, prominently 3-winged, inflorescence 1–7-flowered, forming bifid concinnus, ovary markedly triangular, Kaietuma River, 12 miles up, *F2409*. Bolivia, Brazil (Amazonas and Matto Grosso), Venezuela, and British Guiana.

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[38] By F. P. Jonker. Ref.: Meded. Bot. Mus. & Herb. Utrecht **51**. 1938.

Subtribus *Apterieae*

APTERIA APHYLLA (Nutt.) Barnh. var. HYMENANTHERA (Miq.) Jonk. (35, 207). Erect, simple or branched herb with inclination toward nodding, usually blue campanulate flowers, stamens inserted in crescent-shaped sacs, filaments with two broad rounded wings. SURINAM: frequent in sandy soil of montane forest, vicinity Krappa Camp (2), Saramacca River Headwaters, *24132;* damp place under log, low bush west of Savanna IV, Tafelberg, *24410.* The species occurs from the southern United States to Brazil and Bolivia. This small-flowered variety takes the place completely of the species in Guiana and the southern West Indian Islands; also, together with the species in Brazil and some other West Indian Islands.

DICTYOSTEGA OROBANCHIOIDES (Hook.) Miers var. PARVIFLORA (Benth.) Jonk. (38, 218). Erect herb with a simple stem, forked at the apex, inflorescence a loose double concinnus, flowers small, white, anthers subsessile, not inserted in sacs. SURINAM: frequent in damp floor of low bush, 1 km. south of Savanna I, Tafelberg, *24362.* The species occurs from southern Mexico to southern Brazil, Bolivia, and Peru. This small-flowered variety takes the place completely of the species in Surinam, French Guiana, and Amazonian Brazil; also, together with the species in Trinidad, British Guiana, Venezuela, and Colombia.

GYMNOSIPHON FIMBRIATUS (Benth.) Urb. (187). Stem up to 15 cm. high, rather thick, beset with ovate, acute scales, bearing at the apex a capituliform inflorescence, surrounded by rather large ovate bracts, perianth whitish, the upper third part of the outer perianth lobes beset with a fringe, arranged in two convergent lines and at the margin, at the top a long forked fringe. The present collection showed only one complete flower, of which the fringe was remarkably short and thick, perhaps broken. The forked fringe was missing here. For the first time, deflorated flowers of this species were collected. They showed, in contradistinction to the presumption in my Monograph, that the limb is always deciduous after flowering; the persistent part of the perianth being to 4.5 mm. long. BRITISH GUIANA: frequent on moist loam, mora bush, Kamuni Creek, Groete Creek, Essequibo River, *22811.* This is the first record for British Guiana. The species was twice collected by Spruce in Amazonian Brazil.

GYMNOSIPHON GUIANENSIS Gleason (187). Up to 33 cm. high, herb with a usually simple stem, forked into two, mostly rich-flowered concinnus-arms, pedicels to 3 mm. long, flowers erect, white, limb deciduous, capsule subglobose. BRITISH GUIANA: frequent in mora bush, Kamuni Creek, Groete Creek, Essequibo River, *22815;* locally frequent on white sand, in swampy mixed forest, Waratuk Falls, Potaro River Gorge, *23032.* Recorded from British Guiana only.

ORCHIDACEAE[39]

The following summary of the Orchidaceae collected in British Guiana and Surinam in 1944 includes many species not heretofore recorded from those regions, as well as several concepts which appear to be entirely new. Altogether, therefore, this study which I have been privileged to make shows that primitive sections of the American tropics afford a constant source of surprises.

[39] By Charles Schweinfurth.

The order of genera followed is that proposed by Dr. Rudolf Schlechter, Das System der Orchidaceen, Notizbl. Bot. Gart. & Mus. Berlin-Dahlem **9**: 563–591. 1926.

HABENARIA LEPRIEURII Reichb. f. Linnaea **19**: 376. 1847. A very slender species up to nearly 6 dm. high, with few linear-subulate leaves and a commonly few-flowered lax raceme of minute greenish flowers often variegated with white or yellowish. BRITISH GUIANA: rare terrestrial in sphagnum bog, Kaieteur Plateau, *23288*. Recorded from Trinidad, French Guiana (unlocalized) and Brazil.

VANILLA POMPONA Schiede. Linnaea **4**: 573. 1829. An elongate, mostly stout vine, climbing over shrubs and trees; leaves large, varying from ovate to ovate-oblong or oblong-elliptic, acute or acuminate, 14–30 cm. long; racemes axillary, more or less short, stout, with congested flowers; flowers very large (probably the largest in the genus), lasting for a day, white or yellowish (rarely greenish) with yellow or orange on the lip; perianth tubular-campanulate, about 8–9 cm. long; lip with a scaly appendage but without warty excrescences; fruit trigonous-cylindric, stout, formerly an important source of Vanilla extract. BRITISH GUIANA: rare, in mixed forest, trail from Tukeit to Kaieteur Plateau, *23091*. (The leaves are abnormally narrow in this collection.) Mexico through Central America to Panama, and northern South America to Peru and Brazil.

VANILLA WRIGHTII Reichb. f. Flora **48**: 273. 1865. A slender, elongate vine, climbing over shrubs and low bushes; leaves small, ovate to oblong-elliptic, acute or short-acuminate, with a rounded or subcordate base, usually about 7.5 cm. or less long; racemes axillary, short, slender, few-flowered, loose; flowers about 5–6 cm. long, greenish-yellow to fawn-colored with a white lip which is entirely smooth; fruit very slender, linear-cylindric. BRITISH GUIANA: Kaieteur Plateau, *23176*. SURINAM: frequent in Savanna II, Tafelberg, *24258* (fruit). The West Indies from Jamaica to Trinidad and British Guiana and Surinam.

EPISTEPHIUM sp. aff. *E. parviflorum* Lindl. (flowers poor). Plant erect, slender, about 3 dm. high; leaves on the upper part of the stem, elliptic-oblong, acute or acuminate, short-petioled, up to 8.5 cm. long; racemes short, few-flowered, axillary and terminal, shorter than the leaves; flowers small, pink, about 2.2 cm. long, rather imperfect; ovary to almost 3 cm. long, slender, cylindric, crowned by a plurilobulate cup (as in the genus). SURINAM: terrestrial, in low bush between Savannas II and III, Tafelberg, *24255*. (The abbreviated inflorescences point to a new species.)

ELLEANTHUS LINIFOLIUS Presl, Rel. Haenk. 97. 1827. Plant very slender, up to 40 cm. tall (rarely taller); stems more or less densely caespitose, filiform, leafy; leaves very narrowly linear, acute or sharply tridentate, strict or erect-spreading, up to 10 cm. long; spikes terminal, short (often suborbicular), laterally flattened, distichously few- to many-flowered; flowers minute, white, mostly concealed by the imbricating bracts; lip much broader than the other segments, broadly obovate, concave, saccate at the base, rounded in front. BRITISH GUIANA: rare epiphyte on *Caryocar microcarpum*, along Potaro River above Kaiatuk, *23368*; rare epiphyte, along Potaro River below Tukeit, *23512*. SURINAM: frequent epiphyte in high forest, base of south escarpment, Arrowhead Basin, Tafelberg, *24523*. Also reported from Mexico through Central America to Panama, the West Indies, and most of South America to Brazil and Peru.

SOBRALIA sp. (fruit). Plant tall, stout; leaves elliptic or ovate-elliptic, 19 cm. or more long; fruit about 9.5 cm. long, terminal, cylindric, plurisulcate. SURINAM: frequent on open rocks and in thickets, flowers white, Savanna VIII, Tafelberg, *24434a*.

SOBRALIA sp. (flower agglutinated). Plant rather stout, somewhat branched; leaves (on upper part of stem) lanceolate to elliptic-lanceolate, acuminate, up to 11.5 cm. long; inflorescences axillary, abbreviated, 1-flowered; flower rather large, about 6 cm. long, campanulate, mauve. BRITISH GUIANA: rare, to 2 m. high, straggling habit, beneath low tree, Kaieteur Plateau, *23380*.

SOBRALIA sp. aff. *S. sessilis* Batem. (flower agglutinated). Plant rather tall; leaves up to 20.5 cm. long, elliptic or oblong-elliptic; flower terminal, rather large. SURINAM: frequent terrestrial, flowers white, lip bronze to purple within, in low bush, Savannas II and III, Tafelberg, *24262*.

SOBRALIA LILIASTRUM Lindl. Gen. & Sp. Orch. Pl. 177. 1833; 432. 1840. Plant tall, 2–3 m. high, erect; stem rather stout, leafy; leaves lanceolate or narrowly lanceolate, long-acuminate, 20 cm. or less long; raceme terminal, loosely up to 11-flowered, with a fractiflex rachis; flowers large, white or rose-colored with yellow on the frilled lip; sepals up to 6.5 cm. long. BRITISH GUIANA: locally common terrestrial, Kaieteur Plateau, *23419*. Also recorded from Venezuela and Brazil.

WULLSCHLAEGELIA CALCARATA Benth. Journ. Linn. Soc. **18**: 342. 1881. Plant very slender, leafless; stem to about 5.6 dm. long, suberect and more or less arcuate or flexuous below, minutely hairy throughout; raceme terminal, short to elongate, rather densely many-flowered; flowers minute, with a prominent rather narrow spur-like sac. BRITISH GUIANA: frequent, on floor of mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22921*. Also recorded from French Guiana, Trinidad and Brazil.

ERYTHRODES SANTENSIS (Kränzl.) C. Schweinf. Bot. Mus. Leafl. Harvard Univ. **9**: 128. 1941. *Physurus santensis* Kränzl. in Svensk. Vet.-Akad. Handl. **46**: 39, *pl. 7, f. 6*. 1911. Plant low, with the lower part of the stem apparently prostrate and rooting, the upper part erect, about 15–20 cm. tall; leaves 3–5, on upper portion of stem, lanceolate to lanceolate-elliptic, acute or acuminate, narrowed to a loose tubular amplexicaul petiole, lamina up to 7 cm. long; spike terminal, short, rather densely few- (6- to 15-) flowered, up to 4.5 cm. long; flowers rather small, white; petals cuneate-flabellate, obliquely bilobed above; lip spurred, with a prominent retrorsely lunate apical lobe which is reversed in natural position and presents two linear forcipate lobes. SURINAM: rare epiphyte on moss-covered tree, 2 km. south of East Ridge, Tafelberg, *24593*. Also Colombia and Brazil.

STELIS ARGENTATA Lindl. Bot. Reg. **28**: Misc. 64, No. 78, 1842. Plant very medium-sized for the genus, caespitose, up to about 30 cm. high; stems relatively short, up to 6.6 cm. long, 1-leaved at the summit; leaf linear-oblong to elliptic-oblong, obtuse to rounded with a tridenticulate apex, long-narrowed below to a short petiole, up to 13 cm. long; raceme solitary, commonly much surpassing the leaves, loosely many-flowered, about 20 cm. or less long; flowers small, greenish-purple or green and rose-color; sepals subequal, connate below, densely silvery-pubescent within; petals and lip minute, truncate. BRITISH GUIANA: epiphyte on *Eperua*, in wallaba forest, Takutu Creek to Puruni River, Mazaruni River, *F2102*. Also French Guiana and Venezuela.

STELIS DROSOPHILA Rodr. Gen. & Sp. Orch. Nov. **2**: 88. 1882. Plant very small, caespitose, slender, 5–10 cm. high; stems up to 2 cm. tall, 1-leaved at the apex; leaf linear-oblanceolate, up to 5.5 cm. long; raceme solitary, commonly rather longer than the leaf; flowers very minute, greenish-white or cream-color; sepals subequal, basally connate, petals and lip much smaller. BRITISH GUIANA: locally frequent epiphyte, Kaieteur Plateau, *23338*.

PLEUROTHALLIS BLAISDELLII S. Wats. Proc. Am. Acad. **23**: 284. 1888. Plant small, caespitose, rarely up to 16 cm. high; stems unifoliate, up to 10 cm. long, entirely enveloped by close tubular sheaths with ovate spreading hispid mouths; leaf solitary, erect, oblong-elliptic or elliptic, up to 6.5 cm. long; racemes terminal, solitary or several, much shorter than the leaf, densely several-flowered; flowers very small, dull purple-brown to red (rarely lavender or greenish); segments ciliolate. BRITISH GUIANA: occasional epiphyte, Kaieteur Plateau, *23445* (flowers immature, buds). Also Mexico through Central America south to Panama.

PLEUROTHALLIS GROBYI Batem. ex Lindl. Bot. Reg. **21**: *pl. 1797*. 1836; Bot. Reg. **21**: *pl. 1825* (as *P. picta* Lindl.). Plant small, slender, caespitose, about 11 (rarely 15) cm. or less high; stems very short, 1-leaved at the apex; leaf variable, obovate (rarely suborbicular) to spatulate or very narrowly oblanceolate, obtuse (rarely acute) to rounded and minutely retuse at the apex, long-narrowed below to a petioled base, up to 6.5 cm. long; raceme terminal, solitary, commonly about twice as long as the leaf or more, loosely few- to many-flowered; flowers small, greenish or yellow (rarely white or lavender), often lined with red; sepals ovate-lanceolate or triangular-lanceolate (dorsal) to ovate-lanceolate or oblong-lanceolate (laterals), sharply acute to acuminate, the lateral sepals connate nearly to the apex, concave; petals much smaller, obliquely cuneate-oblanceolate; lip similarly small, ligulate to narrowly oblong. BRITISH GUIANA: epiphyte on Greenheart tree, Takutu Creek to Puruni River, Mazaruni River, *F2131*. Also Mexico, through Central America to Panama, Cuba, and South America to Brazil and Peru.

PLEUROTHALLIS HITCHCOCKII Ames. Orch. **7**: 117. 1922. Plant medium-sized, up to 22 cm. high, caespitose; stems relatively slender, 1-leaved at the summit, up to 13.5 cm. high; leaf erect, elliptic or oblong-elliptic, obtuse, cuneate below, abruptly contracted to a slender petiole, up to 8.5 cm. long; inflorescences abbreviated, 1-flowered, solitary or fascicled, partly concealed by a prominent conduplicate spathe; flowers greenish cream-color, relatively large; sepals lanceolate, long-acuminate, concave, the lateral sepals connate below; petals much shorter, linear-lanceolate, with a single short tooth below; lip slightly longer than the petals, rhombic-ovate, 3-lobed near the base; lateral lobes small, falcate-oblong, incurved and overlapping the mid-lobe; mid-lobe much larger, ovate. BRITISH GUIANA: epiphyte on Greenheart tree, Takutu Creek to Puruni River, Mazaruni River, *F2134*. Apparently endemic.

PLEUROTHALLIS LEPTOPETALA Cogn; Urban, Symb. Antill. **6**: 693. 1910. Plant slender, caespitose, up to 20 cm. high; stems filiform, variable in size, 12.5 cm. or less long, unifoliate at the apex; leaf linear to oblong-elliptic, erect or spreading, sessile, up to 8.8 cm. long; peduncles abbreviated, several, 1-flowered; flowers small, yellowish (rarely whitish); free sepals 2, ringent, ovate; petals linear; lip ovate. SURINAM: frequent epiphyte, high forest,

base of south escarpment at 625 m. altitude, Arrowhead Basin, Tafelberg, *24525*. Also Trinidad and Venezuela.

PLEUROTHALLIS RUSCIFOLIA (Jacq.) R. Br.; Aiton, Hort. Kew. ed. 2, **5**: 211. 1813. The type of this large genus. *Epidendrum ruscifolium* Jacq. Select. Stirp. Am. 226, *pl. 133, f. 3*. 1763. Plant variable, small to medium-sized, up to 39 (rarely 55) cm. high; stems caespitose, commonly numerous, slender, 1-leaved at the apex, about 25 (rarely 38) cm. or less long; leaf erect (rarely spreading), oblong-elliptic (rarely elliptic, linear-elliptic or lanceolate), acuminate, short-petioled, about 13 cm. or less long; peduncles abbreviated, numerous, 1-flowered, surrounded by a concave spathe; flowers small, white, greenish or cream-colored to yellowish; free sepals 2, ringent, concave, lanceolate or lanceolate-ovate, long-acuminate; petals linear, lip ovate. SURINAM: frequent epiphyte, high forest at 625 m. altitude, base of south escarpment, Arrowhead Basin, Tafelberg, *24524* (no flowers). A common and widespread species, extending from Guatemala to Panama, the West Indies and South America to Bolivia and Peru.

PLEUROTHALLIS STENOPETALA Lodd. ex Lindl. Bot. Reg. **24**: Misc. 95, no. 182. 1838. Plant small to medium-sized, up to 40 cm. high, extremely variable both vegetatively and florally; stems slender, caespitose, unifoliate at the apex, up to 13.5 cm. high; leaf obovate-oblong to oblong or oblong-elliptic, rounded (rarely subacute) at the apex, short-petioled; lamina up to 9.5 cm. long; raceme terminal, solitary, much surpassing the leaf, rather densely many-flowered; flowers small to medium-sized, secund, whitish-green to yellow; sepals oblong-linear to linear, acute, more or less pubescent within; petals and lip much smaller. BRITISH GUIANA: rare epiphyte, Kaieteur Plateau, *23102*. Widely distributed in northern South America.

OCTOMERIA BREVIFOLIA Cogn.; Mart. Fl. Bras. **3**[4]: 643, *pl. 133, f. 2*. 1896. Plant small and very slender, up to 19 cm. high; stems filiform, caespitose, unifoliate at the apex, up to 15.5 cm. long; leaf relatively short or very short, subterete, channelled, acute or acuminate; peduncles solitary or two, abbreviated, 1-flowered; flower small, with spreading membranaceous segments; sepals and petals similar, lanceolate or oblong-lanceolate; lip much shorter, sharply 3-lobed near the base with small triangular lateral lobes. SURINAM: epiphyte, abnormally long leaves 4.5–6.5 cm. long, in high bush, east border of Savanna IV, Tafelberg, *24379*. Also British Guiana and Brazil.

OCTOMERIA EXIGUA C. Schweinf. var. **elata** C. Schweinf. var. nov. Herba caulibus et foliis multo longioribus et labelli lobo terminali abrupte acuto a specie differt.

Plant small, caespitose; stems slender, entirely concealed by several imbricating tubular sheaths, unifoliate at the apex, mostly 4–7 cm. long; leaf erect, linear, minutely tridenticulate at the obtuse apex, 2.7 (rarely)–5.5 cm. long (including the short petiole), up to 3.5 mm. wide; peduncles abbreviated, 1-flowered, 2 to numerous; flowers very small, pale lemon-yellow, membranaceous; dorsal sepal oblong-lanceolate, acute, concave, 3-nerved, about 3.8 mm. long and 1.8 mm. wide; lateral sepals very similar but a little smaller; petals similar to the sepals but smaller; lip much shorter than the other segments, rhombic-obovate, about 1.5 mm. long, lightly 3-lobed in front with the lobules subequal, the lateral lobes being rounded and the mid-lobe triangular and acute.

TYPE: Occasional epiphyte, Kaieteur Plateau, British Guiana, May 5, 1944, *Maguire & Fanshawe 23256*. New York Botanical Garden; isotype in Ames Herbarium No. *63079*.

Malaxis Maguirei C. Schweinf. sp. nov. Figure 15. Herba terrestris, pro genere mediocris. Caulis basi leviter dilatatus. Folia duo, e plantae parte inferiore patentia, ovata vel oblongo-ovata, acuta. Pedunculus longus, tenuis. Racemus congestus, umbelliformis. Flores numerosi, late patentes, minimi. Sepalum dorsale ovatum vel elliptico-ovatum, obtusum, convexum. Sepala lateralia simillima, paulo angustiora. Petala lanceolato-linearia, abrupte acuta vel retusa. Labellum in circuitu subquadratum, apice trilobatum, basi breviter biauriculatum. Columna generis.

Plant terrestrial, about 21.5 cm. tall from the base of the plant to the tip of the flower cluster; stem lightly dilated near the base, entirely enclosed by the tubular sheathing base of the leaves and with one or two shorter outer sheaths, about 5 cm. high; leaves two, subopposite, spreading, the blades ovate or oblong-ovate, acute, clasping at base, 6–7 cm. long, 3–4 cm. wide; peduncle long, slender, about 13 cm. high, plurisulcate; raceme congested, umbelliform; floral bracts crowded, very short, ovate, acute; flowers minute, numerous, on widely spreading filiform pedicels which are about 1.5 cm. long; perianth segments widely spreading; dorsal sepal ovate or elliptic-ovate, obtuse, convex, 3-nerved, about 3 mm. long and 2 mm. wide when expanded; lateral sepals very similar but slightly narrower; petals lanceolate-linear, retuse, truncate or abruptly acute, about 3 mm. long and 0.8 mm. wide, 1-nerved; lip deeply concave, subquadrate in outline, terminating in three subequal, triangular, subacute lobules of which the middle one is more porrect, shortly biauriculate at the base with obliquely triangular auricles, lightly retuse on each side, about 3.2 mm. long from the apex of the lip to the tip of a basal auricle and 2.2 mm. wide; disc concave below, with a semi-orbicular-ovate fleshy callus just behind the middle apical lobule; column very short and stout.

This species appears to be allied to the Colombian *Malaxis caracasana* (Kl.) O. Ktze., but differs in its broader acute (not acuminate) leaves and in its short auricles of the lip.

TYPE: Grown in the propagating house of the New York Botanical Garden; description from a photograph and notes sent to the author, together with a raceme of flowers preserved in liquid. Tafelberg, Surinam, May 17, 1945, *Maguire 26212*.

EPIDENDRUM IBAGUENSE H.B.K. var. SCHOMBURGKII (Lindl.) C. Schweinf. Bot. Mus. Leafl. Harvard Univ. **11**: 235. 1944. *E. Schomburgkii* Lindl. Bot. Reg. **24**, *pl. 53*. 1838. Plant large and stout, up to 15 dm. or more tall; stems more or less robust, naked below, rather densely distichous-leaved above; leaves oblong to elliptic-oblong, obtuse to rounded above, sessile and semi-amplexicaul, up to 16 cm. long; peduncle terminal, commonly simple, elongate, leafless but enclosed in close tubular scarious sheaths, flower-bearing above; raceme densely or subdensely several- to many-flowered; flowers orange-pink (rarely salmon-pink) to scarlet, with spreading segments; lip adnate to the column to its apex, commonly deeply 3-lobed with a keel extending through the middle. SURINAM: flowers have a very variable lip, in mixed low bush in ants' nest, near west escarpment, Tafelberg, *24695;* epiphyte, in ants' nest, on tree overhanging Tafelberg Creek, Saramacca

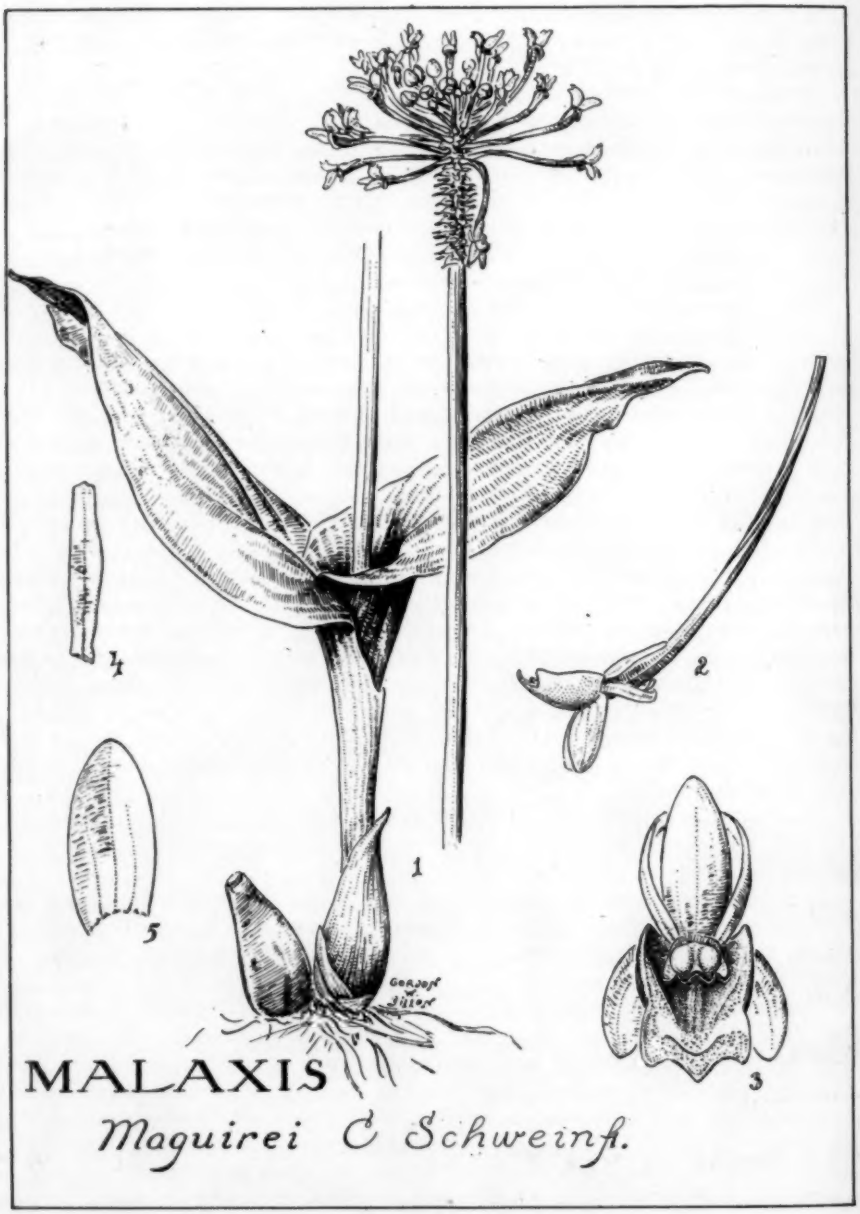

FIG. 15. *Malaxis Maguirei* C. Schweinfurth. *Maguire 26212.*

River Headwaters, *24900* (advanced fruit). Also British Guiana, Trinidad, and Brazil.

EPIDENDRUM IMATOPHYLLUM Lindl. Gen. & Sp. Orch. Pl. 106. 1831. Plant large, rather robust, rarely up to 18 dm. high; stems simple, naked below,

distichously several- to many-leaved above; leaves linear-oblong to oblong (rarely elliptic-oblong), subacute to rounded at the apex, sessile and semi-amplexicaul, rarely up to 18 cm. long; peduncle more or less elongate and concealed by tubular scarious sheaths; inflorescence racemose, sometimes branched, densely (rarely loosely) several- to many-flowered; flowers medium-sized, lavender or rose-color to purple, with spreading segments; petals broader than the sepals; lip adnate to the column up to its apex, simple to obscurely 3-lobed, the lateral lobes (or basal part of lip) more or less lacerate. SURINAM: epiphyte in ants' nest, along Toekoemoetoe Creek, Saramacca River Headwaters, *24916*. Also Mexico and Central America to Brazil and Peru.

Epidendrum latipetalum C. Schweinf. sp. nov. Figure 16. Herba mediocris, terrestris. Pseudobulbus ovoideus, bifoliatus, complanatus. Folia oblonga vel oblanceolato-oblonga, abrupte acuta, inaequalia. Inflorescentia multo altior, laxissime racemosa, pauciflora. Flos mediocris cum segmentis patenti-incurvis. Sepalum dorsale oblanceolatum, acutum. Sepala lateralia similia, oblique elliptico-oblanceolata. Petala obovato-spathulata, sepalis latiora. Labellum columnae basi adnatum, profunde trilobatum; lobi laterales oblique late oblongi, apice crenato rotundato, erecto-incurvi; lobus medius major, suborbiculari-obovatus, marginibus rotundatis undulatisque; discus basi bicarinatus. Columna breviter biauriculata.

Plant medium-sized, terrestrial; roots fibrous, relatively stout, glabrous; pseudobulb complanate-ovoid, bifoliate, about 2.5 cm. high; leaves 2, spreading, very unequal, oblong to oblanceolate-oblong, abruptly acute or subacute, narrowed to a conduplicate base, 12.5–16 cm. long, 2.4–2.7 cm. wide; inflorescence terminal, suberect, about 43.5 cm. high (excluding the apical flower), very loosely racemose above or with an abortive branch below; peduncle rather slender, about 26 cm. long, with four remote short close tubular sheaths; raceme very remotely 4-flowered; floral bracts minute, infundibuliform, acute; flowers rather large, with spreading-incurved subfleshy segments, green suffused with brownish green and lip white striated with mauve, drying blackish; dorsal sepal oblanceolate, acute, about 2.3 cm. long and 9 mm. wide; lateral sepals similar, elliptic-oblanceolate, slightly oblique, acute, about 2.4 cm. long and 8.5 mm. wide; petals obovate-spatulate, slightly oblique, abruptly acute, about 2.2 cm. long and 11.5 mm. wide; lip adnate to the column at the very base, about 1.9 cm. long, deeply 3-lobed; lateral lobes erect and incurved in natural position, porrect, obliquely and broadly oblong, broadly rounded and irregularly crenate at the apex; midlobe much larger, suborbicular-obovate, broadly rounded in front with a minute apicule, cuneate-narrowed below, with recurved margins, about 12.5 mm. long and 10 mm. wide; disc with a pair of thickened approximate ridges below and with many thickened radiating veins above, the anterior margins being undulate and crenate (sometimes lobulate); column rather short and stout, about 12 mm. long, with a pair of suborbicular incurved auricles above; ovary smooth.

There do not appear to be any near allies of this species.

TYPE: rare terrestrial, in shade, Kaieteur Plateau, British Guiana, May 9, 1944, *Maguire & Fanshawe 23327*. New York Botanical Garden.

EPIDENDRUM NOCTURNUM Jacq. Enum. Pl. Carib. 29. 1760; Select. Stirp. Am. 225, *pl. 139*. 1763. Plant very variable and widespread; stems commonly clustered, more or less robust, up to 9 dm. high, leafless below, distichously

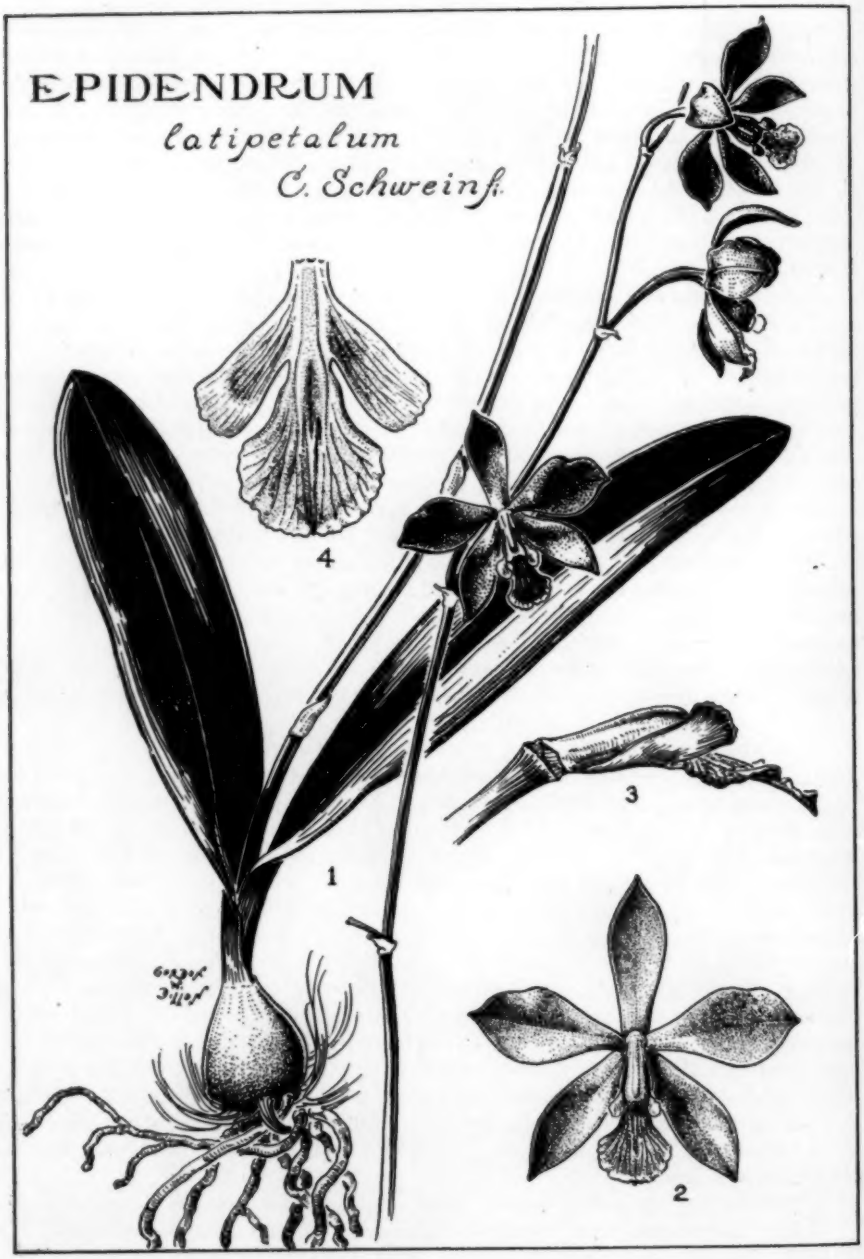

FIG. 16. *Epidendrum latipetalum* C. Schweinfurth. *Maguire & Fanshawe 23327.*

several- to many-leaved above; leaves very narrowly oblong to oval, rounded to subacute at the apex, semiamplexicaul, up to 16 (rarely 18) cm. long; inflorescences terminal, abbreviated, racemose, often several, with commonly but one flower present at a time; flower large, very long-pedicelled, with widespreading segments; sepals and petals similar, linear, acuminate, 3–5 (rarely 7.5) cm. long, white, greenish-white, yellow, reddish-yellow or brown, (rarely tinged with lavender); lip adnate to the column up to its apex, deeply 3-lobed, white turning to yellow; lateral lobes semiovate or aliform; mid-lobe about twice as long, narrowly linear or acicular, long-acuminate. BRITISH GUIANA: stems only to 10 cm. high, frequent on rocks in dry situations, Kaieteur Plateau, *23173*. SURINAM: terrestrial, infrequent, in shallow bogs, Savanna I, Tafelberg, *24217;* frequent on rocks and in thickets, Savanna VIII, Tafelberg, *24434*. Also Florida, Mexico through Central America to Panama and the West Indies to Brazil, Bolivia, and Peru.

EPIDENDRUM ONCIDIOIDES Lindl. Bot. Reg. **19**: *pl. 1623*. 1833. Plant tall, rather slender, very variable, up to 10 dm. high, from a creeping rhizome; pseudobulbs broadly ovoid to fusiform or cylindric, 2- to 3-leaved near the apex, concealed by scarious sheaths, up to 10 cm. high; leaves elongate, linear, obtuse to acute, up to 60 cm. long, erect or ascending; inflorescence much surpassing the leaves, loosely paniculate (rarely subsimple) above, with short few- to several-flowered branches; flowers medium-sized, with widespreading segments, brown and yellow; sepals oblanceolate or elliptic-lanceolate; petals elliptic-spatulate to round-spatulate, commonly broader than the sepals; lip adnate to the base of the column, deeply 3-lobed, up to 15 mm. long; lateral lobes erect and clasping the column, very oblique, oblong, pandurate or ovate; mid-lobe with a short isthmus, suborbicular-ovate or suborbicular to transversely oval; disc below with two fleshy ridges which extend into fleshy radiating lines above; column stout, with a pair of apical incurved rounded auricles. SURINAM: frequent terrestrial, in shallow bogs, Savanna I, Tafelberg, *24216;* Gran dam, Saramacca River, *24928*. Also Mexico to Honduras and northern South America to Brazil.

EPIDENDRUM PURPURASCENS Focke, Tijdschr. Natuurk. Wetensch. **4**: 64. 1851. Plant medium-sized, from a short creeping rhizome; pseudobulbs stipitate, fusiform-clavate, compressed, several-jointed, rarely up to 24 cm. high, 1- or 2-leaved above; leaves linear-elliptic, oblong or oblong-elliptic, acute, cuneate at the sessile base, up to 22.5 cm. long; inflorescence racemose above, equaling or exceeding the leaves, subtended by several imbricating distichous compressed sheaths; raceme loosely few- to several-flowered; flowers small to medium-sized, subtended by large scarious bracts; sepals and petals green, often tinged with purplish on the back; sepals elliptic-linear or elliptic-oblong, with revolute margins; petals similar, narrower; lip adnate to the column up to its apex, deeply 3-lobed, white; lateral lobes obliquely semiovate or aliform, irregularly dentate or lobulate on the outer margins; mid-lobe spatulate or obovate, abruptly dilated above, acute or short-acuminate at the apex; column arcuate above. SURINAM: epiphyte, Tafelberg, *26214;* infrequent on rocks in high mixed forest, Schmidt Mountain, km. 7, Saramacca River Headwaters, *24882*. Also Costa Rica and northern South America.

BRASSAVOLA sp. (fruit) aff. *B. cucullata* (L.) R. Br. Stems slender, entirely enveloped by loose tubular, scarious sheaths, about 12–18 cm. high,

1-leaved at the apex; leaf linear-terete, up to 27.6 cm. long; ovary ellipsoid, produced into a long slender beak about 8 cm. long. SURINAM: frequent epiphyte, red fruit, river-side en route to Pakka Pakka, Saramacca River, *23959*.

BRASSAVOLA MARTIANA Lindl. Bot. Reg. **22**: sub *pl. 1914*. 1836; **25**, *pl. 5*. 1839. Plant medium-sized to large; stems approximate on a creeping rhizome, entirely enveloped by several elongate tubular scarious sheaths, up to 16 (rarely 25) cm. long, 1-leaved at the apex; leaf linear-terete, longitudinally sulcate, up to 24 (rarely 50) cm. long, more or less curved; inflorescence terminal, much shorter than the leaves, loosely to subdensely few- to many-flowered above; pedicellate ovary slender, elongate, about 7–9 cm. long; flowers medium-sized but small for the genus, with widespreading segments, greenish or white with a white lip; sepals linear-lanceolate, long-acuminate, the lateral ones oblique; petals elliptic-linear; lip shorter but much broader than the other segments, simple, ovate, acuminate, fimbriate or lacerate-dentate; column short, stout. SURINAM: epiphyte, overhanging Tafelberg Creek, Saramacca River Headwaters, *26200*. Also British Guiana and Brazil.

SCAPHYGLOTTIS VIOLACEA Lindl. Bot. Reg. **22**, *pl. 1901*. 1836. Plant slender, sprawling, more or less elongate; stems superposed, often fascicled, each member somewhat swollen in the living plant and 2-leaved at the apex, the lowest ones about 14 cm. or less long; leaves subopposite, linear or oblong-linear, bilobulate at the obtuse apex, sessile, up to 12 (rarely 16) cm. long; flowers terminal, 2 to several, on very short 1-flowered peduncles, very small, rose-purple or violet with white on lip; mentum or chin formed by the lateral sepals prominent; lip ligulate-spatulate, lightly undulate above on each side, callose-thickened in the middle. BRITISH GUIANA: occasional epiphyte, Kaieteur Plateau, *23162;* epiphyte on upper branches of a wallaba and common on other trees, Barabara Creek, 14 miles Bartica-Potaro Road, *F817*. Also Brazil and Peru.

POLYSTACHYA LUTEOLA (Sw.) Hook. Exot. Fl. **2**: *pl. 103*. 1824. *Cranichis luteola* Sw. Fl. Ind. Occ. **3**: 1433. 1804 ? Plant small to medium-sized, variable, up to about 3.6 (rarely 5) dm. high; stems short, approximate, more or less bulbose-thickened at the base, entirely concealed by sheaths which are leaf-bearing above; leaves 2 or more, erect-spreading, elliptic or elliptic-oblong to oblong or oblanceolate-oblong, acute or obtuse, amplexicaul at the narrowed sessile base, up to 25 (rarely 32) cm. long; inflorescence generally exceeding the leaves; peduncle entirely enveloped by tubular scarious sheaths; flower cluster racemose or more commonly loosely paniculate, several- to many-flowered, the branches commonly secund; flowers very small, yellowish or yellowish-green, with a conspicuous chin or mentum; lip 3-lobed in the middle with the lateral lobes small, obliquely semiovate and porrect; disc with a long pubescent callus in the middle. BRITISH GUIANA: frequent epiphyte on *Sapodilla*, river tidal flats, vicinity of Mazaruni Forest Station, *23581*. Florida, Central America from Guatemala to Honduras, the West Indies and northern South America to Brazil, Colombia and Peru. Also Philippines and perhaps other Pacific Islands.

EULOPHIA ALTA (L.) Fawc. & Rendle, Fl. Jam. **1**: 112, *pl. 22, f. 4–8*. 1910. *Limodorum altum* L. Syst. Nat. ed. 12, **2**: 594. 1767. Plant large, up to about 12 dm. high; leaves (commonly appearing after the inflorescence) elliptic-oblong or oblanceolate-oblong, acuminate, 3–7, imbricating at the long-sheathing base, about 8.4 (rarely 11.5) dm. or less long; scape basal, lateral,

much surpassing the leaves, up to 12.7 dm. high; raceme elongate, loosely many-flowered; flowers medium-sized, pinkish, reddish-brown or green with brownish-green or purple lip; petals broader than the sepals; lip deeply concave at the base, lightly 3-lobed above the middle; disc with a pair of short keels and many scattered tubercles. SURINAMS along railroad, Km. 70, *23635*. Florida, Mexico through Central America, to Panama, the West Indies and northern South America to Brazil, Peru, and also West Africa.

CYRTOPODIUM ANDERSONII (Lambert) R. Br.; Aiton, Hort. Kew. ed. 2, **5**: 216. 1813. *Cymbidium Andersonii* Lambert in Andrews' Bot. Repos. **10**: *pl. 651*. 1811. Plant large and showy; pseudobulbs elongate, robust, fusiform or subcylindric, many-jointed, about 6–10 dm. high, the younger ones clothed with the persistent sheaths of the older leaves, many-leaved above; leaves 8–12, elliptic-oblong or narrowly oblong-lanceolate, acute or acuminate, up to 6 dm. long; scape basal, lateral, robust, exceeding the leaves, up to 16 dm. tall, above loosely branched to form a large pyramidal many-flowered panicle; floral bracts large, ovate or ovate-lanceolate, spreading or reflexed, yellow-green; flowers medium-sized, with spreading segments, yellow, the sepals tinged with greenish; sepals oval-ovate not or scarcely undulate; petals broadly obovate; lip clawed, deeply 3-lobed near the middle; lateral lobes obliquely semiorbicular, spreading; mid-lobe broadly obovate-reniform, with a broadly rounded and retuse apex; disc irregularly warty near the apical margin. SURINAM: locally frequent on rocks, Grasi Falls, Saramacca River, *24939*. Widely distributed in South America from British Guiana to Brazil and Uruguay.

MORMODES sp.? (advanced fruit). Plant stout, rather small; pseudobulb cylindric, covered by several scarious imbricating sheaths, about 12 cm. long, with several leaf-sheaths near the apex; no leaves present; scape lateral, basal, strict, 5-jointed, bearing at the summit a large ellipsoid fruit about 4 cm. long, with a short, stout, apparently twisted column. SURINAM: frequent terrestrial, Savanna I, Tafelberg, *24219*.

CATASETUM sp. ♀. Plant stout, about 24 cm. high; pseudobulb oblong-ovoid, about 6 cm. long, mostly concealed by dilated leaf-sheaths; leaves about 7, elliptic, acute or acuminate, up to 18 cm. long, the upper blades mostly tapering to a petiole; scape lateral, basal, shorter than the upper leaves, densely few-flowered at the summit; lip much the largest member of the yellowish flower, entirely deeply saccate, apparently semiglobose. SURINAM: epiphyte, on islands in Brokoboto Rapids, about 3 hours' above Pakka Pakka, Saramacca River, *23994*.

CATASETUM DISCOLOR Lindl. Bot. Reg. **27**: sub *pl. 34*. 1841. *Monachanthus discolor* Lindl. Bot. Reg. **20**: *pl. 1735*. 1835. Plant medium-sized to large; pseudobulb oblong-ovoid to oblong-fusiform, several-jointed, 5–17 cm. long, more or less concealed by the dilated bases of the leaf-sheaths; leaves about 7 or less, deciduous below but congested above, oblong-elliptic (rarely obovate-oblong), acute or short-acuminate, up to 40 cm. long; scape of male flowers lateral, basal, erect or ascending, about 25–65 cm. or more tall, rather loosely 3- to many-flowered above, more or less surpassing the leaves; male flowers small for the genus, nodding, greenish suffused with brown and lip yellowish (rarely purplish) with yellow and purple within; sepals and petals narrow, reflexed, membranaceous; lip uppermost, relatively large, fleshy, semiglobose, lightly 3-lobed in front with the margins fimbriate;

scape of female flowers similar, often shorter, loosely few-flowered; all parts of flower fleshy, larger than the male flowers, the lip being relatively large, entire, deeply saccate. SURINAM: frequent, grass savanna, Zanderij II, *23698, 23699;* common in open rock savannas, Tafelberg, *26210.* Also British Guiana, Brazil, and Venezuela.

CATASETUM PLANICEPS Lindl. Bot. Reg. **29**: *pl. 9.* 1843. Plant large, similar to the other species of the genus; pseudobulbs clustered, oblong-ovoid to subfusiform, many-jointed, 8–22 cm. long, entirely concealed by the dilated bases of the leaf-sheaths when young; leaves about 6–9, elliptic to elliptic-oblong, acute or acuminate, up to 35 cm. long; scapes of the male flowers lateral, basal, erect, shorter or slightly longer than the leaves, about 45 cm. or less high, subdensely about 6-flowered above; flowers medium-sized, yellowish with the lip greenish and yellow-margined; sepals and petals membranaceous, elliptic-oblong or obovate-oblong, acute or apiculate, more or less connivent; petals elliptic, broader; lip much larger than the sepals and petals, fleshy (especially in front), deeply saccate, with the porrect apex triangular-acute and the erect sides broadly rounded and more or less serrate; column with a pair of slender equal antennae. SURINAM: common in open rock savannas, Tafelberg, *26211.* Venezuela, British Guiana, and Brazil.

PERISTERIA PENDULA Hook. Bot. Mag. **63**: *pl. 3479.* 1836. Plant large and showy; pseudobulbs clustered, oblong-ovoid or elongate-conic, lightly compressed, 3- or 4-leaved near the apex, 6.5–15 cm. long; leaves large, elliptic-oblong, acute, gradually petiolate-narrowed below, up to 70 cm. long, convolute; scape lateral, basal, pendent, slightly longer than the pseudobulbs, up to 18 cm. long, above subdensely 4- to 8-flowered; flowers rather large, fleshy; segments subglobose-connivent; sepals oblong-ovate (dorsal) to round-ovate (laterals); petals elliptic-ovate, smaller than the sepals, all whitish-green outside, dull reddish inside with fine purplish spots; lip smaller than the other segments, divided into two parts, whitish or yellowish finely spotted with purple; lower (basal) part with a pair of spreading subquadrate-rounded lobes; upper (anterior) part strongly recurved, ovate-oblong with an erect fleshy keel on each side; column very short and stout, with a pair of oblong porrect auricles. SURINAM: infrequent on rocks in high mixed forest, Schmidt Mountain, Km. 7, Saramacca River Headwaters, *24883.* British Guiana, Brazil and Peru.

Polycycnis surinamensis C. Schweinf. sp. nov. Figure 17. Herba epiphytica, spectabilis. Pseudobulbi aggregati, oblongo-ovoidei vel oblongo-ellipsoidei, subtetragoni ut videtur, unifoliati vel bifoliati. Folium magnum, petiolatum; lamina elliptica vel elliptico-oblonga, acuta, plicata. Inflorescentia lateralis, pendula, supra laxe pluri- vel multiflora. Flores mediocres, lutei, fuscomaculati. Sepalum dorsale concavum, lanceolato-ellipticum, acuminatum, valde reflexum. Sepala lateralia oblique elliptico-lanceolata, quam sepalum dorsale paulo breviora et latiora. Petala anguste linearia. Labellum lanceolato-lineare, dimidio inferiore longe fimbriato, basi callo trilobato libero ornata. Columna gracillima, arcuato-incurva, apice alato-dilatata.

Plant epiphytic, showy; pseudobulbs aggregated, numerous, apparently oblong-ovoid to oblong-ellipsoid and subtetragonous, unifoliate or bifoliate at the apex, about 5 cm. or less long; leaves large, petioled, about 20–39.5 cm. long; lamina elliptic-oblong to elliptic, sharply acute, cuneate at the base, pli-

FIG. 17. *Polycycnis surinamensis* C. Schweinfurth. *Maguire 24581.*

cate with 5–7 main ribs, 15–34 cm. long, up to 10.6 cm. wide; petiole about 5–6 cm. long; inflorescence lateral, pendent, laxly several- to many-flowered above, about 40–80 cm. long; peduncle slender, densely purple-pubescent, about 22–30 cm. long, provided at the base with several imbricating short tubular sheaths and above with 4–5 remote larger tubular hirsute sheaths; raceme loosely several- (10-) to many-flowered, about 30–51 cm. long, with rachis densely short-pubescent; floral bracts linear-lanceolate, acuminate, concave, pubescent; flowers medium-sized, with widely spreading segments, yellow spotted with brown; sepals rather densely dark-pubescent without; dorsal sepal concave, lanceolate-elliptic, acuminate, about 3 cm. long, 6.4–8 mm. wide, 7-nerved, strongly reflexed in natural position; lateral sepals obliquely elliptic-lanceolate, acuminate, reflexed, concave, dorsally carinate, 2.5–2.7 cm. long, 8–9.3 mm. wide, 7-nerved; petals narrowly linear, acute, 2.9–3.3 cm. long, about 1 mm. wide, 3-nerved below, apparently strongly reflexed below the middle; lip lanceolate-linear, acute or acuminate, with a complicate tip, about 2.2–2.6 cm. long and 1.8 mm. wide, provided on each side below the middle with numerous long fringes, adorned near the base with an oblong pubescent fleshy callus (with a minute tooth at the base) which merges into a prominent 3-lobed, free, pubescent callus of which the lateral lobes are spreading-upcurved and semiobovate and the mid-lobe is larger, laterally flattened, very fleshy and semielliptic to conic-semiorbicular when viewed from the side; column very slender, arcuate-incurved, about 2.7 cm. long, abruptly dilated at the apex with a pair of obliquely round-ovate porrect wings and a deflexed, linear-triangular, fleshy, rostellar process.

This species is apparently unique within the genus in the characters of the lip.

TYPE: frequent, flowers on the outer surface and lip pale buff spotted with pink-brown, upper petals pale yellow, rostellum green with yellowish tip, in medium bush, 2 km. south of East Ridge, Tafelberg, Surinam, September 1, 1944, *Maguire 24581*. New York Botanical Garden; isotype in Ames Herbarium No. *62927*. Also Venezuela (Cerro Duida).

STANHOPEA GRANDIFLORA (Lodd.) Lindl. Gen. & Sp. Orch. Pl. 158. 1832. *Ceratochilus grandiflorus* Lodd. Bot. Cab. *pl. 1414*. 1828. Plant large and showy; pseudobulbs clustered, conic-ovoid or oblong-ovoid, plurisulcate or corrugated, 1-leaved at the apex, 2.5–7 cm. high; leaf distinctly petioled; lamina oval to elliptic-oblong, acute, cuneate below, up to 40 cm. long; petiole up to 8 cm. long; scape short, pendent, up to 12 cm. long, with several loose or imbricating cucullate sheaths below, 1- or usually 2-flowered above; flowers large to very large, ivory-white often marked with pink or lavender, with spreading or reflexed segments; sepals ovate-oblong (dorsal) to obliquely oval-ovate (laterals), membranaceous; petals linear-oblong to broadly oblong; lip very fleshy, pandurate-oblong in outline; basal portion semiglobose-saccate with a small incurved horn or tooth on each side of a large central cavity; middle part oblong and very thick, sulcate within, slightly dilated above, retuse in front; apical part triangular, convex; column long, slender, arcuate, lightly semielliptic-winged on each side. SURINAM: epiphyte, Tafelberg, *26215*. Also Trinidad, Venezuela, British Guiana, and Brazil.

BIFRENARIA BICORNARIA Reichb. f. Hamb. Gartenz. **19**: 12. 1863. Plant medium-sized; pseudobulbs clustered, ovoid, 4-angled, shining, 1-leaved at the apex, 1.5–4.5 cm. high; leaf petioled; lamina oblanceolate or oblong-

elliptic, acute, cuneate below, 9.5–17.5 cm. long; petiole 2.5–4.5 cm. long; scape lateral, basal, erect, slender, loosely several- (about 5-) flowered above, 25 cm. long; flowers rather small, pale yellow with red-brown spots or bars; sepals elliptic-ovate (dorsal) or obliquely oblong-ovate (laterals), the latter being wider and forming a chin or mentum with the column-foot; petals oblanceolate-elliptic, much narrower than the sepals; lip prominently 3-lobed near the middle, short-clawed; lateral lobes small, retrorse, semielliptic, irregularly crenate-dentate without; mid-lobe much larger, semiorbicular, subtrilobed with undulate-crisped margins; disc with a large warty callus at the base and in front an ovate-subquadrate smooth fleshy callus; anther with 2 lateral horns. SURINAM: dry cliff bases of west escarpment, Tafelberg, *26199*. Also Brazil and Peru.

MAXILLARIA DESVAUXIANA Reichb. f. Bonplandia **3**: 67. 1855. Plant medium-sized; pseudobulbs clustered on a shortly creeping rhizome, rather small, ovoid or pyriform-ovoid, compressed, 3–4.5 cm. long, 1-leaved at the apex, concealed by triangular evanescent sheaths; leaf long-petioled; lamina oblong or elliptic-oblong, acute, shortly cuneate below, up to 35 cm. long; petiole up to 15 cm. long; scape lateral, basal, ascending, shorter than the pseudo-bulb, entirely concealed by several loose, triangular, imbricating sheaths; flower medium-sized; sepals ovate-oblong, acute, apiculate, the laterals forming a short chin or mentum, yellowish-brown or pale bronze; petals obovate-oblong, yellowish-brown with purple mottling; lip smaller than the other segments, ovate or ovate-oblong when spread out, sharply 3-lobed above with the lower part tubular-involute, deep purple; mid-lobe suborbicular or subquadrate, warty-callose on the upper surface. SURINAM: epiphyte in high bush, east of North Ridge, Saramacca River, *24344*. Colombia, French Guiana, and Brazil.

MAXILLARIA VIOLACEO-PUNCTATA Reichb. f. Bonplandia **3**: 216. 1855. Plant large and stout; pseudobulbs often clustered, large, 5.5–10 (rarely 13) cm. high, strongly compressed, oblong-cylindric, 1-leaved at the apex, more or less concealed by 2 pairs of conduplicate leaf-bearing sheaths; leaves broadly oblong to linear-oblong, rounded or subacute at the obliquely bilobed apex, more or less gradually narrowed below to a conduplicate, petiole-like base, up to 69.5 cm. long; scapes few, erect, a little shorter (rarely longer) than the pseudobulb; flower medium-sized to rather large, bright green or cream-color to yellow with violet spots on the lip; sepals oblong (dorsal) to elliptic-oblong (laterals), acute; petals much smaller, obliquely oblanceolate-oblong, acute or acuminate; lip ovate in outline, recurved, more or less sharply 3-lobed above the middle, with the lower part tubular-involute; mid-lobe strongly produced, triangular, much thickened. SURINAM: epiphyte, near White Rock Rapids, between Grasi Falls and Posoegronoe, Saramacca River, *24010*. British Guiana, Brazil and Peru.

IONOPSIS UTRICULARIOIDES (Sw.) Lindl. Coll. Bot. *pl. 39A*. 1825. *Epidendrum utricularioides* Sw. Prodr. Veg. Ind. Occ. 122. 1788. Plant small to large, variable; stems more or less elongate, with solitary or clustered 1-leaved pseudobulbs which are minute to 3 cm. long and surrounded by leaf-bearing sheaths; leaves linear to oblong (sometimes conduplicate and recurved), acute and apiculate, more or less narrowed to a sessile base, rarely up to 16.2 cm. long; scape lateral, basal, much surpassing the leaves, racemose or more commonly spreading-paniculate, several- to many-flowered, about 11–76 cm. high; flowers rather small, white, pale rose or lavender; sepels

small, oblong or ovate-oblong; petals larger, elliptic-oblong; lip about twice as long as the other segments, broadly obcordate, bilobed. BRITISH GUIANA: rare epiphyte on low tree, Kaieteur Plateau, *23100*. Also Florida, Mexico through Central America to Panama, the West Indies and most of South America.

BRASSIA WAGENERI Reichb. f. Bonplandia **2**: 14. 1854. Plant large, pseudobulb large, oblong-ellipsoid or subcylindric, about 9–12 cm. high, 2- to 3-leaved near the apex, provided below with several pairs of imbricating sheaths of which an upper one bears a small leaf; leaves elliptic-oblong, acute, gradually narrowed below to a sessile conduplicate base, about 31 cm. or less long; scape lateral, basal, in the axil of a sheath, slender or stout, about 12.7 dm. or less tall, rather loosely several- (6-) to many-flowered; flowers large, with widespreading segments; sepals linear-lanceolate, setaceous-acuminate, bright green to pale yellow; petals similar but somewhat shorter, blackish-brown below; lip rhombic-obovate, rather abruptly long-acuminate and cuspidate, the lower part narrow and rounded at base, green with brown spots below; disc at base with a pair of low keels, smooth (except at base) and ending with a dilated abrupt tooth. BRITISH GUIANA: rare terrestrial, in shade, Kaieteur Plateau, *23326*. Venezuela and Colombia.

ONCIDIUM PUSILLUM (L.) Reichb. f. Walp. Ann. **6**: 714. 1863. *Epidendrum pusillum* L. Sp. Pl. ed. 2, 1352. 1763. Plant dwarf, variable, epiphytic, up to 8 cm. high; stem obscure or none; leaves several to numerous, equitant, radially spreading to form a flabelliform or suborbicular cluster, imbricating below; blades unjointed, oblong-linear to (rarely) elliptic, more or less oblique, acute or subacute, up to 7.2 cm. long; scapes lateral, axillary, about equaling the leaves, compressed, densely 1- to several-flowered at the apex; flowers yellow, large to very large in relation to the plant, with widespreading, membranaceous segments; dorsal sepal elliptic-ovate or obovate, commonly acute; lateral sepals oblong-lanceolate, acuminate; petals ovate-oblong, larger than the dorsal sepal, commonly obtuse; lip much larger than the other segments, deeply 3-lobed; lateral lobes small, obovate-suborbicular; mid-lobe much larger, ovate-semiorbicular or reniform in outline, abruptly 4-lobed in front; disc at base with a several-lobed flat callus. BRITISH GUIANA: rare, Kaieteur Plateau, *23099*. Mexico through Central America to Panama, Trinidad and most of northern South America.

SIGMATOSTALIX AMAZONICA Schltr. Beih. Bot. Centralbl. **42**[2]: 148. 1925. Plant small, slender, variable, rarely up to 25 cm. high; pseudobulbs clustered, oblong-ellipsoid, complanate, 1-leaved at the apex, up to 2.8 (rarely 3.5) cm. high, surrounded on each side by two or three imbricating sheaths of which the upper pair bears a small leaf; leaves linear to elliptic-oblong, acute, gradually narrowed below to a more or less distinct petiole, up to 14.5 cm. long; scapes lateral, basal, in the axil of the inner sheath, slender, erect to ascending, several- to many-flowered, rarely up to 18 cm. long, forming a narrow wand-like panicle with commonly very short loosely few-flowered branches; flowers very small, membranaceous; sepals and petals narrow, oblong, similar, greenish-white, olive or yellowish, barred with pink or brown; lip larger than the other segments, yellow, simple, cuneate-obovate or flabellate, rounded in front; column very slender. SURINAM: rare epiphyte in damp high bush, base of north escarpment, Tafelberg, *24330*. Brazil and Peru.

LOCKHARTIA sp. aff. *L. micrantha* Reichb. f. (sterile). Plant medium-sized, caespitose; stems numerous, spreading, up to 30.5 cm. long, entirely concealed by very numerous, distichously imbricating leaves; leaves equitant, small, obliquely triangular (when viewed from the side), obtuse or subtruncate at the apex, about 1.8 cm. or less long on the outer margin; no flowers present. BRITISH GUIANA: epiphytic in *Manicaria* swamp, flowers solitary, axillary, stalked, subtended by pale green amplexicaul bracts, 3 outer petals pale greenish-yellow, reflexed, 2 inner ones the same color, spreading lip yellow, finely marked with brown, stigma hooded, pale green, Kaituma River, Sebai Creek, *F2420*.

DICHAEA sp. Plant small, caespitose; stems spreading, 11 cm. or less high, entirely concealed by imbricating leaf-sheaths; leaves very numerous, loosely distichous, linear-oblong, acute, mucronate, complicate below, sessile at the articulated base, up to 3.3 cm. long, spreading-ascending; inflorescences very short, axillary, 1-flowered; floral fragments on summit of ellipsoid densely echinate ovary. BRITISH GUIANA: rare epiphyte, Kaieteur Plateau, *23343*.

DICHAEA sp. (sterile) aff. *D. muricata* (Sw.) Lindl. Plant small, simple; stem suberect, up to 17.5 cm. long, entirely concealed by the abruptly sheathing bases of the leaves; leaves very numerous, densely or subdensely distichous, small, horizontally spreading, oblong, abruptly acute and mucronate, about 1.9 cm. or less long, unjointed, with semiamplexicaul imbricating bases, the anterior margins being ciliolate; no flowers present. BRITISH GUIANA: rare, on moist rock surfaces in high mixed forest, Potaro River Gorge, *23531*.

DICHAEA sp. Plant small, caespitose, possibly conspecific with *23343;* stems spreading, up to 13 cm. long, entirely concealed by the imbricating leaf-sheaths; leaves very numerous, loosely distichous, linear or oblong-linear, acute, mucronate, complicate below, sessile at the articulated base, up to 3.3 cm. long, spreading-ascending; old fruit ellipsoid, densely echinate. SURINAM: frequent epiphyte, high forest, base of south escarpment, Arrowhead Basin, Tafelberg, *24522*.

DICHAEA RENDLEI Gleason. Bull. Torrey Club **54**: 604. 1927. Plant small, slender, caespitose, stems slender, spreading, straight or lightly flexuous, up to about 17 cm. long, entirely concealed by imbricating leaf-sheaths; leaves slender, numerous, distichous, articulated, ascending-spreading, linear or linear-oblong, abruptly acute, mucronate, about 2.5 cm. or less long; inflorescences rather numerous, abbreviated, axillary, 1-flowered; flower very small, white, membranaceous; sepals ovate to oblong-lanceolate, the lateral sepals oblique; petals ovate or ovate-lanceolate; lip anchor-shaped, apiculate at the broadly rounded apex, produced near the middle on each side into a recurved obliquely linear-oblong lobule, long-cuneate toward the base. BRITISH GUIANA: occasional epiphyte on *Eperua*, wallaba forest, on Bartica-Potaro Road, *23557;* between Demerara and Berbice Rivers, *De la Cruz 1623* (type). Perhaps also Trinidad and Guadeloupe.

CAMPYLOCENTRUM MICRANTHUM (Lindl.) Rolfe, Orch. Rev. **11**: 245. 1903. *Angraecum micranthum* Lindl. Bot. Reg. **21**: *pl. 1772*. 1836. Plant medium-sized or rather large; stems very variable in length, simple, rather stout, up to 42 cm. or more long, entirely concealed by close tubular leaf-sheaths, freely rooting below or throughout; leaves numerous, loosely distichous, narrowly oblong, elliptic-oblong or broadly elliptic, commonly obliquely bi-

lobed at the obtuse apex, sessile at the cuneate or subrounded base, up to 8.6 (rarely 12.5) cm. long; inflorescences lateral, 1 or 2 together, commonly nearly opposite the leaves, more or less shorter than the leaves, densely many-flowered to the base, commonly secund-flowered; flowers very small, white; sepals and petals narrow, acute or short-acuminate, parallel below with often recurved apices; lip with a prominent curved clavate spur; lamina lanceolate in outline, distinctly 3-lobed below the middle, with the lateral lobes short and dentiform and the mid-lobe much longer, triangular-lanceolate and porrect. BRITISH GUIANA: rare epiphyte in mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22922*. Mexico through Central America to Panama, the West Indies and most of northern South America.

BULLETIN OF THE TORREY BOTANICAL CLUB
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TORREYA

PROCEEDINGS OF THE CLUB

Minutes of the Meeting of October 7, 1947. The meeting was called to order at the Brooklyn Botanic Garden at 8: 30 p.m. by the President, Dr. Shull. Thirty members and friends were present.

Dr. Shull announced that the speaker at the October 15th meeting at Hunter College would be Dr. Naylor of the New York Botanical Garden.

Many of the members present then told of their summer experiences which included observations in the local field and the more distant fields of Canada, the Gaspé, and Greenland.

The meeting was adjourned at 9: 55 p.m. and was followed by refreshments served by Dr. and Mrs. Graves.

Respectfully submitted,
HONOR HOLLINGHURST,
Acting Recording Secretary

Minutes of the Meeting of October 15th, 1947. The meeting was called to order by President Shull at 8: 30 p.m. at Hunter College. Fifty-two members and friends were present. The minutes of the preceding meeting were accepted as read. Dr. Shull announced that there would be no meeting on Election Day, November 5th, and that the meeting of November 19th would be held at the New York Botanical Garden.

Dr. Naylor of the New York Botanical Garden staff then spoke of the interesting work involved in planning and producing motion picture films at the Garden. Two films, the first depicting scenes and activities at the Garden and the sound film, "The Gift of Green," were then shown to the meeting.

The meeting adjourned at 9: 55 p.m. and refreshments were served by the Botany department of Hunter College.

Respectfully submitted,
HONOR HOLLINGHURST,
Acting Recording Secretary

Minutes of the Meeting of December 17, 1947. The meeting was called to order at the New York Botanical Garden at 3:30 p.m. by President Shull. Twenty-three members and friends were present. The minutes of the preceding meeting were approved as read. Dr. Shull then introduced the speaker, Dr. Conrad B. Link, of the Brooklyn Botanic Garden staff. Dr. Link spoke on the topic of "Botanical Research Applied to Commercial Horticulture." The abstract of his talk follows:

> Many of the results of recent botanical investigation have led to their application in the field of commercial horticulture. Research in the field of photoperiodism and the influence of light on plants has resulted in the commercial use of additional light in the growing of certain greenhouse flowers especially annuals, during the winter. A long day may be produced with ordinary mazda lamps, resulting in a more rapid growth and earlier flowering. Short day treatment of fall-blooming chrysanthemums is a regular part of the florist's program to produce better flowers earlier in the season than normal. Just now there is considerable interest in prolonging their period of bloom so that they may be available as cut flowers during the spring months, by artificially manipulating the day length.
>
> The great interest in soilless culture has found practical application under greenhouse conditions, especially for rose growing, and to a lesser extent for carnations and tomatoes. The "gravel" method has been found most practical for greenhouse conditions.
>
> In the field of hormones and related chemicals, so many new developments

have been found for this group of materials that the many commercial possibilities are barely started. The first widespread commercial use of these was in the field of plant propagation where indole butyric acid and napthalene acetic acid have now become standard products. Other applications have been found for the use of hormones in producing seedless fruits, and insuring a set of fruit on tomatoes; preventing or delay in the pre-harvest drop of apples, and aiding in the ripening of such fruits as bananas and apples. The use of 2, 4-Dichlorophenoxyacetic acid as a selective weed killer is widespread for lawns, fields, pastures, along roadsides and in vacant areas. Much research is continuing with this and other materials for weed control. Many other discoveries in the control of plant growth with chemicals are now beginning to find some use, such as breaking or delaying the dormancy especially in potatoes; and controlling the flowering of pineapple.

In the field of plant breeding the use of chemicals to induce polpoidy is now a part of the breeder's equipment, while the use of embryo culture is of considerable value with many plants. Many other phases of botanical research provide direct or additional information which find commercial application. To mention only a few would include diseases and their control, genetical studies of horticultural plants, plant nutrition and ecological studies.

After the discussion period, the meeting was adjourned at 4:30 p.m. Tea was then served by the Garden staff.

Respectfully submitted,
HONOR HOLLINGHURST,
Acting Recording Secretary

Minutes of the Meeting of December 2, 1947. The meeting was called to order at 8:05 p.m. at Columbia University by President Shull. Approximately 90 members and friends were present. The minutes of the preceding meeting were approved as read.

Fourteen persons were elected to Active Membership, and two to Associate Membership. One resignation from Associate Membership was accepted with regret.

Dr. Shull then introduced Dr. Paul Burkholder of Yale University who spoke on the topic of "Studies of Growth Factors of Microorganisms."

After a discussion and question period, the meeting was adjourned at 9:35 p.m. Tea was served by the Botany Department of Columbia University.

Respectfully submitted,
HONOR HOLLINGHURST,
Acting Recording Secretary

Minutes of the Meeting of November 19th, 1947. The meeting was called to order at 5:30 p.m. by President Shull at the New York Botanical Garden. Twenty-five members and friends were present. The minutes of the preceding meeting were approved as read.

Ten persons were unanimously elected to Active Membership, and seven to Associate Membership. Prof. Nicholas Polunin of Montreal was elected a Life Member.

Dr. Shull then introduced the speaker, Dr. Edwin B. Matzke, whose subject was the "Three-Dimensional Shapes of Epidermal Cells." Lantern slides and models of the various cell shapes were used to illustrate the talk. The speaker's abstract follows:

Upper epidermal cells of the leaf base of *Aloe aristata* were studied in position, and number and kinds of faces were recorded. This epidermis was selected because its cells were relatively regular and uniform and underlain by cells of approximately the same volume as those of the epidermis. The average number of faces for 200 cells was 10.885, the range being from 8 to 16. The faces varied from triangular to octagonal; 48.6 per cent were pentagonal.

Epidermal cells of the meristematic stem apex of *Elodea*, above the place of origin of the leaf primordia, were similarly studied in total mounts. The average number of faces for 200 cells was 10.005, with a range from 7–14. Pentagonal and quadrilateral faces were most common. The deviation from 11 in

Elodea is explained by the presence of subepidermal cells greater in volume than the epidermal. The meristematic epidermal cells of *Elodea* were not markedly different in shape from those of the more mature leaf epidermis of *Aloe*. In both instances the similarity to peripheral bubbles in a foam was greater than to peripheral compressed shot, emphasizing the significance of surface forces in three-dimensional cell shape determination.

After a discussion of the talk, the meeting was adjourned at 4:45 p.m.

Respectfully submitted,
HONOR HOLLINGHURST,
Acting Recording Secretary

Report of the Field Committee. A program of fifty-four field trips was arranged for the week-ends between March 23, and November 9, 1947. Nearly fifty members and friends of the Club contributed their ability and time to lead these trips. Some of the trips were joint affairs with other organizations having similar interests; at other times we were the guests of other groups. The printed schedule makes due acknowledgements.

When available, reports of the trips have been published under Proceedings, in the Torreya Section of the Bulletin. Trips ranged from objectives reached by the New York City subways to places in Connecticut, New Jersey, Pennsylvania, Kentucky, and the Province of Quebec. This was the second trip around Gaspé for the Torrey Club.

The Local Flora Committee. In the spring of 1947 the Council put the Local Flora Committee under the same chairmanship as the Field Committee. This has resulted in no material changes in the activity of either committee to date, but certain things may perhaps be more properly reported as Local Flora Committee activities. Our By-Laws instruct the Local Flora Committee "to prepare complete and accurate lists of all the plants, native, naturalized, and adventive, occurring within one hundred miles of New York City. . . ." These lists as currently available are somewhat out of date. The leaders of some field trips have compiled check lists of a few localities. Additions have been made to these during 1947, notably the list from Cheesequake State Park and from the Forked River area.

Two of our members, Mrs. F. C. Dunham and Mr. G. G. Nearing, were asked to make a survey of the proposed Greenbrook Sanctuary in the New Jersey section of Palisades Interstate Park. Three trips were scheduled through the season for this purpose and a comprehensive list has been compiled.

In response to requests made on field trips for an explanation of plant names, one of our members, Mr. Hollis Koster, has prepared a list of about two hundred-fifty scientific names with their derivations. This will be mimeographed for distribution to those interested.

Mention was made, in reporting the appropriate trip (Forked River, June 21–22), of the discovery of a small colony of *Listera australis* Lindl. Another unusual species from the same locality is *Epilobium rosmarinifolium* Pursh, a segregate from *E. densum* Raf. Ours is said to be the only known coastal plain station. The extension of the range of *Myrica cerifera* L., the story of the rediscovery of *Fossombronia cristula* Aust., and the successful search for *Telaranea nematoides* (Aust.) Howe in the pine barrens were described in reporting the Mullica River Valley trip of August 30–September 1.

In view of its own responsibility, the Local Flora Committee is anxious to record any lists of plants from our range that may be published by others. During 1947 two of our members, M. A. Chrysler and J. L. Edwards, issued the *Ferns of New Jersey* (eighty-one species with descriptions, photographs, and maps of distribution—Rutgers University Press, $4.00). Another member, G. G. Nearing issued *The Lichen Book*, 648 pages; a great many species in which are described from material collected locally (published by the author, Box 338, Ridgewood, New Jersey).

JOHN A. SMALL,
Chairman

FIELD TRIP REPORTS

June 28–29. Hunter Lake, New York. This lake in the Catskills at 2200 feet elevation is in a richly forested area. Nearby Mud Pond affords a northern bog habitat, with large expanse of shrubby plants, *Chamaedaphne*, sheep laurel, etc., with spruce and larch invading. Plants mentioned in the report included *Sorbus americana*, *Ilex monticola*, *Luzula saltuensis*, *Waldsteinea fragarioides* (an exceptionally large patch of this), *Menyanthes trifoliata*, *Vaccinium Oxycoccus*, *Viburnum alnifolium*, *Sambucus racemosa*, *Acer spicatum*, *Streptopus roseus*, *S. amplexifolius*, etc. Pteridophytes included some less common species as *Asplenium angustifolium*, *Onoclea struthiopteris*, *Aspidium goldianum*, *Phegopteris polypodioides*, *Botrychium lanceolatum* var. *angustisegmentum*, *B. ramosum* (= *B. matricariaefolium* of recent authors).

Attendance 19. Leader, J. A. Crabtree.

August 17. Cheesequake State Park, New Jersey. A joint trip with the Academy of Natural Sciences of Philadelphia. The walk included Arrowsmith Point, Barton Spring, and the white cedar swamp near the museum. *Strophostyles umbellata* (Muhl.) Britton was found. The northern coastal limit of this plant is Long Island. *Sagittaria latifolia* Willd. is a common arrowhead of the central Jersey Region. *Apocynum cannabinum* L., *Crotalaria sagittalis* L., *Plantago aristata* Michx., *Ipomoea hederacea* Jacq., *Lycopus americanus* Muhl., *Desmodium rotundifolium* (Michx.) DC., *Rhus glabra* L., *Lespedeza procumbens* Michx., *Typha latifolia* L., *Lechea Leggettii* Britton & Hollick, and *Collinsonia canadensis* L., were also added to our list from the Park.

Attendance 25. Leader, L. E. Hand.

August 30–September 1. Mullica River Valley, N. J. The group visited a station for *Myrica cerifera* L. discovered in the spring of 1947 by L. E. Hand at Lower Bank. The plants were in good fruit. This is thought to be the northernmost station known for this species. The group then visited Green Bank, Weekstown, Bulltown, Batsto, and Pleasant Mills. Among species seen were *Isoetes Brauni*, *Schizaea pusilla*, *Prenanthes autumnalis* (*P. virgatum*), *Rhyncospora microcephala*, *Scleria nitida*, *Eupatorium resinosum*, *Breweria pickeringii*, *Crotonopsis elliptica* (*C. linearis*), *Gentiana porphyrio*, *Lobelia canbyi*, *Sphagnum macrophyllum*, *Fossombronia cristula*, and *Telaranea nematodes*.

"As Mr. Beals and Mr. Nearing were along, we concentrated no little on hepatics and collected about 20 species of these. Here came the fun. As *Fossombronia cristula* was first collected at Batsto by Austin, we searched particularly for this. We found *Fossombronia* several times but too early for fruit desired for determination as to species. This has now been done and rediscovery of this species in the pine barrens is now established.

"I think I shall tell a bit about the *Telaranea;* it seems very interesting. It is the best example I know of what is called an 'Atlantic species' of moss. Its occurrence rings the coastal regions of this ocean from deep in Africa to deep in South America. Collections through the years have been few and widely spaced geographically. It did not turn up in the United States until relatively late years. In 1910 Miss Haynes cited several stations in coastal United States (the first report made upon its occurrence in this country). Mr. Beals has turned it up twice from high points in the Catskills. He found traces in three specimens taken on this trip (the normal way it is found). He expressed curiosity as to whether it was ever collected except as straggling strands amongst other hepatics. I suspect it has been collected more or less pure in at least one tropical collection as a note was made on its facies.

"To find it so readily in the pine-barrens (the first it has been collected here, we can well suppose) was an unavoidable challenge to search out some material pure enough to call a 'real specimen' of *Telaranea*.

"It was one of those unencouraging searches—it hid totally for a while. Then I spotted weak traces and spent several hours scraping up bits of muddy material. I attempted washing, and dried specimens were merely small disappointing-looking plates of dried mud. Hoping to process better specimens, I returned and re-collected. Began to get dark so walked up the ditch toward the highway. On way with my handful of

scrapings, the eye caught a plate of peculiar-looking material on the bank of the ditch. It was about six square inches of massed cushions of pure *Telaranea!* A hasty search seemed to suggest that I could expect no more. I suspected that this colony had taken some unique notion to proliferate freely.

"Of course it is a romantic species (to hepatologists) and perhaps has a privilege to behave so elusively. The next search (of course with better clues as to where it may be found—it is not actually difficult to spot when one faces it) more was found, and more abundantly at another site. The pine-barrens had finally come through grandly."

Attendance 9. Leader, Hollis Koster.

September 14. Cheesequake State Park, New Jersey. The area along Cheesequake Creek near the old steamboat dock was visited first for the mud flat habitat. The old field near the museum yielded some new weed species. Salt marsh was traversed near the spring and then the group explored Bluebell Island. Asters, goldenrod, and other composites were plentiful as were fall maturing grasses. Eight or ten new species were added to our lists.

Many additions have been made to all of our lists and revised copies will be made available to any who request them.

Attendance 14. Leader, John A. Small.

September 21. Franklin Lake, New Jersey. Some members of the Yosian Alpinist group and of Newark Nature Club were our guests. Attention was primarily devoted to the evergreens, native and introduced, though the ground plants were not without interest. This walk is pleasant just for the sort of country it traverses.

Attendance 10. Leader, Dr. H. B. Gordon.

October 4–5. Island Beach and pine barrens of New Jersey. A joint trip with the Connecticut Botanical Club. Zonation around ponds of varying salinity at Point Pleasant was followed by observation of the coast strip type of forest as we followed up the Metedeconk River. Typical pine barrens were seen in the vicinity of Lakewood Airport. The group then went to Forked River for a good pine barrens bog with the usual fall aspect.

On Sunday we visited Island Beach for plants of the dunes, thickets, forests, and littoral aspects displayed so nicely there. The *Hudsonia* heath attracted much comment. Holly berries were attractive and other species showed the features to be expected in autumn.

Attendance 16. Leader, John A. Small.

October 11. West Park, New York. The Torrey Club had made no autumn pilgrimage to Slabsides, the rustic retreat where John Burroughs did much writing, in many years. This joint trip with members of the John Burroughs Association was enjoyable from the autumnal aspect of the vegetation and surroundings. The day was ideal. Perhaps there were more highlights among the company than among the plants observed. The report notes, "Edwin W. Teale, Dr. Clyde Fisher, Professor Inez Haring, Princess Teata, and Julian Burroughs. Julian and Dr. Fisher read parts of John Burrough's essays relating to Slabsides."

Attendance 24. Leader, N. H. Moldenke.

October 12. Princeton, New Jersey. The group put to sea on Lake Carnegie, portaged the canoes to Millstone River, and paddled up to a point affording an easy walk to Walker-Gordon Pond. Aquatic species included spatterdock, pickerel-weed, bur-reed, *Sagittaria*. Alders along the shorelines attracted attention. The 1948 staminate catkins were already visible; female units for 1946, 1947, and 1948 were found. Autumn coloring was noted in *Cornus*, sweet gum, sour gum and ash. Conspicuous fruits were evident on winterberry, spicebush, and hawthorn. Birds included three great blue heron (one very tame), five species of *Charadrii*, six or seven species of Anatidae.

Attendance 7. Leader, C. H. Rogers.

October 19. Schunermunk Mountain, New York. This hike started from the Mountain Lodge colony, climbing up through the oak-hickory forest on an unmarked trail.

Lichens and fungi were perhaps best represented at the season though other species of plants and animals, including a wood frog, were not overlooked. The summit trail was followed nearly to the high point. A blue blazed trail was then followed left leading a steep and rocky descent onto a bottomland, still well up on the mountain, where a swampy area rewarded the hepaticologists in the group. A short walk led to the cabin colony but a thunderstorm accelerated our progress considerably. Food and, where necessary, dryness were provided at the leaders' pleasant lodge.

Attendance 10. Leader, Alexander V. Tolstoouhov.

October 26. Budd Lake, Morris County, New Jersey. The ecologist is always concerned with physiography and our first assignment was to climb a fire tower and see how the terminal moraine across New Jersey had brought Budd Lake into existence. Vegetation tends to exterminate lakes. Bud Lake is not in danger of disappearance but it is smaller than that created by the glacier. There was an island then. The island has been connected with the main land by an encroaching bog and swamp growth. Northern plants such as spruce and larch were seen. A floating mat was reached at the water's edge and some members took a swim from this. The water was found to be cold, deep, muddy, but exhilarating. It was determined that if the mat is extending at the point visited its progress is exceedingly slow. A red maple four or five inches in diameter was within a few inches of the water's edge. It was decided that ice and the action of storm waves hold the invading plants in check.

Attendance 31. Leader, Murray Buell.

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COMPILED BY

LAZELLA SCHWARTEN

WITH THE COLLABORATION OF THE EDITOR OF THE TAXONOMIC INDEX

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